

August 26, 1963

Aviation Week & Space Technology

75 Cents

A McGraw-Hill Publication

TFX Program
Subcontract
Management

USAF/Sikorsky CH-3C
Rear-Loading Helicopter





Only Their Performance Reveals Voi-Shan Quality

Voi-Shan's acknowledged leadership in the high-strength aerospace industry field is maintained by the very high performance "built-in" to every quality product from the procurement of raw material thru actual application of the product; every phase involves constant attention and control. To supply the widest range of proprietary fastening concepts demands an unequalled metallurgical expertise and a superior customer engineering service to fully complement the products.

SHUTTER CHANNEL SYSTEM
TORSION SPRINGS
WILSON STRENGTHENED PANEL FASTENERS
MICROFASTENERS
MICROFASTENED LUMINARIES
THERMOSET PLASTIC
REFLECTIVE MATERIALS
THERMOSET PLASTIC
COMPOSITE MATERIALS
THERMOSET SUPER METAL ALLOYS

This Voi-Shan innovation in modern production technology is also found in a wide range of special fasteners designed to conform to all Voi-Shan specifications. A large variety of 12 pt. external lockwashers bolts, as well as ASI and NAS standards are readily available. Send us your letterhead for fully descriptive literature. Inc.

VOI-SHAN MANUFACTURING COMPANY
5453 HIGUERA STREET, CULVER CITY, CALIFORNIA
A DIVISION OF VM CORPORATION



Patent Pending - U.S. Patent Office - International Bureau - D.O.P.

**CHR harmonizes different materials....
with charming results**



CHR's Custom Group can fabricate to suit the oddest shapes. It makes flexible assemblies, for example, out of materials that begin where others leave off. □ The snake above, for instance, combines neoprene, fiberglass, aluminum and phenolic plastic. This formed snake is serving very nicely as an electronic door duct. The tube and basket are fabricated from neoprene, fiberglass, silicone rubber and brass. Neoprene, plus a few wire rings to boot. □ You won't have to be a design whiz. Let CHR's Custom Group put the magic in your product. You'll be charmed with the results. Connecticut Hard Rubber Company, New Haven, Conn.

CHR

where
the shapes
of things
to come
are
formed
every day

Potpourri

In Defense Control Corporation: 1. An off-recognition of our natural Movement and Control capabilities for steering and balance. 2. Fine guidance over one's reading. 3. To enhance our belief that we're not alone.

General Controls Corporation
100 South Main Street, Suite 2000



HOPE WANTED

NO RESUMES, PLEASE

A few resumes, they are a money investment, and resumes with enough experience to sell. Tom Morrison, am striking up a VP what they think. While there is little left here, I am working on space measurement and control progress and why you'd like to be up with a friend working multi-dimensional mathematics on the press. He's home. As soon as we're



0000 MILITARY DIGITS

Under instructions of Secretary, State, and -55°C to +155°C ambient temperature range, the team of Control Computer Systems Time Series. They accurately measure, analyze and accumulated data in hours in days, seconds, or fractions thereof, even under severe military operating environments. Control Computer Timing Accuracy are having a major impact on the reliability of MIL-STD-875B time. They will accurately record total operating or non-operating time for any type of electronically controlled equipment. And Control Systems will last a minimum of 30,000 hours.

IN LEVEL FLIGHT, DO AIRCRAFT WINGS MOVE AT IDENTICAL SPEEDS?

- NO We do move.
YES We do not move.
SOMETIMES (Write them in clockwise or counter-clockwise)



UNIDENTIFIED FLYING OBJECT—RE: 1

Experts see the necessary evidence. A Boeing 747, a Boeing 727, a Boeing 707, what it looks like speed and frequency, 4 times up or down from an China, then the Philippines a plane per 200 and 234 mph squared the 200s. Who made it? What was its Army number? See for more of course.

BOOK REVIEW

The World Set Free Author's viewpoint is best expressed in the following passage: "The world must have been more advanced in 1914 than it is now, and it must be more advanced in 1945 than it was in 1914. And the progress which world war was bringing into life. And in certainly they did not see it. They did not see it coming from the bottom horn in their funding banks."

The World Set Free by H. G. Wells
Published in 1914 by P. Dutton & Co.



RUGGED RATE GYROS

Industries, Inc., West Palm Beach, probably has a couple of these new Gummey Rate Gyros in the air. They may be the most rugged rate gyros ever made. They are designed for harsh environments, such as aircraft, and can withstand 20 G's of V.M. with no failure. The power source is DC AC converter.



Recently in a demonstration sponsored by

AGARD, a dynamically balanced model fitted with a special self-reversing servo system, was demonstrated on its own aircraft. In order to observe, a test aircraft, Germany's Autorenkommando Krenzsch, descended the system. It's called Model 79.

Test results prove that Model 79 is extremely responsive and completely fail-safe. It can turn from end with total load and response aerospace vehicle development programs. Write me right now!

AEROSPACE CALENDAR

Sept. 4-6—National Control Workshop, Stevens, Cleveland, Ohio. Commercial Aerospace Society of Test and Measuring Devices, Thompson-Ramo-Wooldridge.

Sept. 4-6—Open Space and Peace, a Seminar on Effects of Changes in Standard Units of Measurement, Callan Research Center Institute on War Resolution and Peace Studies, Elmont Products.

Sept. 8—International Symposium on High Temperature Technology, Antwerp, Belgium. American Research Inst. Sept. 10-12—Meeting of the Institutes Asia of Canada, Major Research University, Quebec.

Sept. 8-9—Annual Statistical Quality Control Institute, University of Colorado, Boulder, Colo.

Sept. 9-11—Joint National Conference in Military Electronics, Institute of Electrical and Electronic Engineers, Sheraton Hotel, Washington, D.C.

Sept. 9-12—19th Annual Instrumentation Conference & Exhibit, Instrument Society of America, McCormick Place, Chicago, Ill.

Sept. 9-12—International Conference on Production Engineering Research, Garage Institute of Technology and Webster Hall Hotel, Greenwich, Pa.

Sept. 14-16—National Symposium on Space rendezvous, Rendezvous and Recovery, Ed.

(Continued on page 7)

AVIATION WEEK & SPACE TECHNOLOGY

August 26, 1963
Vol. 25, No. 5

Editorial: The new AGASWITCH® is a switch that can be controlled by a single button. It is controlled by the pressure of a finger on a button. Once started, the cycle continues to complete with high accuracy repeatability, regardless of electrical or environmental variations.

AGASWITCH is equipped with fast delays or any type of logic selectable ranges covering a total span from .03 to 200 seconds. One or four pole switch models are available, with capacities up to 10 amperes at 120vac, 60hz, high resistive. In standard units the switch transfers when the button is pressed, turning arms when button is released, and the switch returns to its initial position at the end of the delay period.

An exclusive "pulse cycle" action can also be supplied, in which the switch transfers and comes back simultaneously when the button is pressed, and no end return motion of the switch cycle is possible until the switch returns to its initial position.

Hermetically sealed (MIL Spec) as well as unsealed models are immediately available from AG-ASTAT®—leader in time-delay instrumentation for over 30 years. Write Dept. A-10 for specifications or engineering assistance on your specific requirements.

AGASTAT TIMING INSTRUMENTS
ELASTIC STOP NUT CORPORATION OF AMERICA
ELIZABETH DIVISION ■ ELIZABETH, NJ 07202



...and the new
AGASWITCH®

www.agastat.com

provides high-accuracy delayed switching from .03 to 180 seconds

No coils, transistors or current —
no motors, gears or clutches to wear

Here's the most accurate and reliable time/delay switch ever designed for manual operation! The new miniature AGASWITCH® is activated by a touch of the button. Delay is controlled by the pressure of a person's finger. Once started, the cycle continues to complete with high accuracy repeatability, regardless of electrical or environmental variations.

AGASWITCH is equipped with fast delays or any type of logic selectable ranges covering a total span from .03 to 200 seconds. One or four pole switch models are available, with capacities up to 10 amperes at 120vac, 60hz, high resistive. In standard units the switch transfers when the button is pressed, turning arms when button is released, and the switch returns to its initial position at the end of the delay period.

An exclusive "pulse cycle" action can also be supplied, in which the switch transfers and comes back simultaneously when the button is pressed, and no end return motion of the switch cycle is possible until the switch returns to its initial position.

Hermetically sealed (MIL Spec) as well as unsealed models are immediately available from AG-ASTAT®—leader in time-delay instrumentation for over 30 years. Write Dept. A-10 for specifications or engineering assistance on your specific requirements.

AGASTAT TIMING INSTRUMENTS
ELASTIC STOP NUT CORPORATION OF AMERICA
ELIZABETH DIVISION ■ ELIZABETH, NJ 07202



Aero Valetan
Main Undercarriage

UNDERCARRIAGES by **DOWTY**

DOWTY EXPORTS LTD., CHELTENHAM, ENGLAND • DOWTY ROTOR INC., ARLINGTON, VIRGINIA, USA
DOWTY EQUIPMENT OF CANADA LTD., AURORA, ONTARIO, CANADA

AEROSPACE CALENDAR

(Continued from page 51)

Wade AFB, Calif. Sponsored American Astronautical Society, Air Force Flight Test Center.

Sept. 10-12-New York University's Third Annual Air Transport Conference, Washington Square Campus, New York, N.Y.

Sept. 13-14-East Coast Convention, Navy League of the United States, Boston, Mass.

Sept. 14-16-17th Annual National Contractors & Aerospace Engineers, Air Forces Asia, Shingletown Park and Shingletown Inn Hotel, Washington, D.C.

Sept. 15-16-Aerospace and Instrumentation Conference, Union Electronics, Los Angeles, Calif.

Sept. 16-18-International Aircraft Research and Development Symposium At Inverness City, N.J. Sponsored FAA.

Sept. 18-19-1965 American Optics and Microelectronics Conference, Millville, N.J.

Sept. 19-20-Third Annual Conference on Environmental Effects on Aircraft Structures, U.S. Naval Air Warfare Test Station, Tustin, Calif.

Sept. 20-21-11th Annual Conference on Components and Materials in the Design of Electrical and Electronic Equipment, Rand Research, Santa Barbara, Calif.

Sept. 20-25-Ninth Annual International International Trade & Travel Fair, San Mateo Convention Center, Houston, Tex.

Sept. 23-25—Second International Aerelastic and Dynamic Modelling Technology, Biltmore-Miramar Hotel, Dayton, Ohio. Sponsored Air Force Systems Command's Aerelasticity Division, U.S.A.F.

Sept. 23-27-Second International and Space Engineering and Manufacturing Meeting and Display Society of Automotive Engineers, Anaheim Hotel, Los Angeles.

Sept. 28-29—International Telecommunications Conference, Savoy Plaza, London, Eng. Sponsored International Committee of Electrical Engineers (London), Royal Society of Aeronautics and Astronautics, Institute of Electrical and Electronics Engineers, Institution of America.

Sept. 24-Biennial Annual Convention and Aircraft Show, National Business Aviation Association, Hilton Hotel, Houston.

Sept. 25-26-Second Annual Symposium on the Physics of Failure in Electronics, Chilcoy, Ill. Sponsored Kansas Area Development Center, Kansas Research Foundation, Inc.

Sept. 26-Oct. 1-14th Congress, Internationale Fédération Astronautique, Paris.

Sept. 27-30-Security of Experimental Test Pilots' Seventh Annual Report to the Aerospace Professions and Services for Safety of Aviation Handling Safety Handout.

Sept. 30-Oct. 1-Monthly Industry Information Meeting, American Institute of Accountants and Astronomers, California Motor Hotel, Palo Alto, Calif.

Sept. 30-Oct. 2-CanaGas Electronics Conference, Inst. of Electrical and Electronic Engineers, Institute of Electrical and Electronics Engineers, Postwarren Hotel, Miami Beach, Fla.

(Continued on page 9)

Nine Position Tilt Ability

WITH TEKTRONIX
TYPE 200-SERIES
SCOPE-MOBILE®
CARTS

Photo courtesy of Tektronix Inc.

Easily adjustable up or down from bench height



- **STORAGE DRAWER** holds probes, clip leads, adjustment items.

- **LIMELIKE TOPPED STEEL SHELF** holds auxiliary instruments.

- **FRONT-WHEEL BRAKES** lock with foot lever, unlock with foot lever.

- **STURDY PORTABLE SUPPORT** rolls on black rubber wheels, weight approximately 40 pounds, stands approximately 3 feet high, 2.5 feet deep, with tray width dependent upon the model selected.

- **ADJUSTABLE TRAY** locks in one of 5 positions: bench-height position, 8° forward tilt position, 8° rearward tilt position, 15° left/bank movements.

- **PLUG-IN CART** houses 2 plug-in units, storage tray accessible and dust-free, adjustable feature on two models only.

Here are five models of Tektronix Scope-Mobile® Carts—for easy portability and sturdy support of your Tektronix Oscilloscopes and associated instruments.

Characteristics of Type 200 Series Scope-Mobile® Carts

Model Number	Tray Width	For Tektronix Oscilloscopes	Storage Drawer	Plug-In Cart	Storage Cart
200-1	105"	30B, 30A, 310A, 31B, 31A, 30	Yes	No	\$195
200-2	105"	Yes	Yes		\$230
200-3*	94"	30EA1, 301, 302A, 301A, 301, 302, 304, 305, 306, 307 Series	Yes	No	\$195
200-4*	94"	Yes	Yes		\$230
200-5	117"	30B, 30A, 310A, 31B, 31A, 30	Yes	No	\$230

*Type 200-4 and 200-5 will also accommodate Type 310 and 315 Curve Traces.

†For use with a Type 302A, a special adapter (part number 430-930, kit 2140) is required.

© 1968 by Tektronix Inc.

610 Main P.O. Box 501 Portland, Oregon

CALL YOUR TEKTRONIX FIELD ENGINEER FOR A DEMONSTRATION.

Tektronix, Inc.

14210 NE 65th Avenue • Beaverton, Oregon 97006 • Div. of ITT • 503/627-3100 • Telex 338-174 • Circle 12 on Reader Service Card

Tektronix 1968 Offices are located in principal cities throughout the United States. Please consult your Telephone Directory - Tektronix Canada Ltd., Virden Office in Montreal, Quebec • Tektronix (Vancouver) Ltd., Vancouver, B.C., Canada • Tektronix Ltd., Gosport, Chichester, England

**SEARCH, PINPOINT
and RETURN
with *CERTAINTY***



the PHI 200



HELICOPTER NAVIGATION SYSTEM



HELICOPTER NAVIGATION SYSTEM

Navigation problems of Anti-Submarine-Warfare Helicopters are complicated by constantly changing positions of submerged submarines and the movement of base ships or convoys. These problems are efficiently solved with the PHI 200 and its specialized A.S.W. Systems Options.

The multiplicity and complexity of search patterns plus the difficulties imposed by adverse weather conditions are matched by the all-weather capability of helicopters combined with the operational simplicity of the PHM 200. Input sources of the PHM 200 are Doppler and Directional Gyro, Terrain and Magnetic Compass or Internal Platform,

The PHF 200 is a further development of the *Position and Motion Analysis Navigation System* designed and developed by Computing Devices of Canada Limited. The PHF system (adopted by 10 Nations of the Free World) have received universal acclaim for their reliability, accuracy, versatility and low maintenance costs.

The Associate, held high in the lead of the class of Seven at Chappell during the Education Building in Denver, Colorado, was an ardent conservation advocate of great assistance to the early explorers of the new world. He symbolized the progressive spirit of his company as an exponent to prove the new and vastly complicated expansion processes of some.



**Computing Devices
OF CANADA LIMITED**
P. O. BOX 2200, OTTAWA 2, ONTARIO, CANADA
AN AFFILIATE OF THE SERVCO CORPORATION

AEROSPACE CALENDAR

(Continued from page 7)

-



*Primary
heat exchanger
source:
Janitrol*

The long range high performance Douglas DG-8 has four Jacobs hot exhausts in its air conditioning system. Located behind the lower engine nacelle in each engine nacelle, these primary exchanges reduce engine bleed air temperatures from 850° to 450°F. Since space is limited the units were designed to be compact and thermally efficient. One unusual qualification requirement is that the exhaust must withstand 5000 temperature expansion cycles. Material is type 347 stainless; heat transfer material thickness is 0.025"; base is 15" x 14" x 16" D.

When you need a heat exchanger or an oil cooler, Jantzen's approach to heat exchanger reliability can be an important design asset. We regularly work in stainless steel and aluminum on piping plate and fin, *d*-spaced plate, tubular and PlateauTM techniques. Request bulletin JA 218 from the Jantzen Metal Division of Michelin-Ross Corporation, 4200 Surface Road, Columbus 4, Ohio.

本章題解



JANITROL AERO DIVISION
Midland-Ross Corporation

THIS IS
MARK CENTURY
SERVICE



He gives your control the 3rd degree

Progress Is Our Most Important Product

GENERAL ELECTRIC

Your Mark Century numerical control is thoroughly tested before it leaves our factory. An automatic circuit tester probes the thousands of electrical connections for accuracy and good contact. Check tapes specially prepared for your control check out the logic circuitry. A microvalve simulator tests its performance under operating conditions. Thus, at the machine tool builder's plant, a Mark Century Service Engineer takes over. He runs through pre-planned checks and performs adjustments to make sure the control matches perfectly with your machine. If your control has unusual features, the Service Engineer gets a special orientation at the factory and participates in the final testing. The result of this scrutiny: better performance and greater economy in your plant. If you want a fine control and service to match, satisfy Mark Century . . . and get Mark Century Service.

Specialty Control Department, Waynesboro, Virginia

703-941

TWO MORE FOR SPACE FROM DI/AN™

available now — from production



MINI-MATT RESET COUNTER:

- capacity 200 events
- counting rate 0 to 100,000 cps.
- maximum count from 1 to 255, programmable
- opto-isolated and logic-preserved digital output
- 40-volt logic pulses several counts for minimum preset
- programmable and ready choices of preset counts
- 16-bit word count interrogation output, single or multiple, choice of 8 formats
- -50°F to +180°F operating
- -50°F to +180°F storage
- dust-proof by GEL/AF



SUB-MINIATURE MEMORY:

- 36,000 bit sequential access memory
- instantaneous read/write time is 20 μsec. full rate
- volume less than 70 cc. & in.
- weight: 25.0 lbs.
- Read/Write or Core/Write modes
- no external heating or temperature control required
- 20-milliamp standby power
- -50°F to +180°F operating
- 20 sec. 1024 bit write time available
- Dual Memory by DI/AN

HISTORY: NO ONE depicts more accurately than we do the evolution of reliability in magnetic tape equipment for space. Prod. 1. The accounting history of these devices (and their predecessors) approaches a million hours in over 30 different aerospace programs with no known failure.

RELIABILITY: This mind you is a record of actual use of our clocks, timers, counters, memory modules etc. The record is superlative by two life tests of the individual magnetic Core Transistor Logic modules (CTL's), with which these equipments are made. The Tests have logged 316 million module hours over 8 years — no failures. And 126 million module hours over 2 years — no failures. These numbers are for complete logic elements — but compare them with numbers for simple components!

This adds to the history and reliability. The unique advantages inherent in CTL, magnetic tape design, low power

low capacitance, fast critical switch-off times, permanent no incremental hysteresis, resistance to radiation and low temperature limitations. Plus, extended range, high, low, and controlled currents. Over 1000 types of log controls, CTL's, per year (over 1000 CTL's make a justifiable GPM expenditure).

SHORT DELIVERY: One type of magnetic tape element is used for all functions — function determined by interconnection. New equipments are built with almost no lead-time engineering time required. Product line units like those listed above are available on short delivery from current production.

WRITE FOR DATA SHEETS and special report on "MAGNETIC LOGIC IN SPACE — A REPORT ON HISTORY AND RELIABILITY".

ALSO AVAILABLE: Literature covering three other DI/AN product lines: ■ Magnetic Logic and Register Modules and systems ■ Standard Core Memories ■ Data Systems

Di/An Controls, Inc.

1100 EAST BELMONT AVENUE • MILWAUKEE 14 • WISCONSIN 53202 • TEL: 321-7641



**FROM FAFNIR... BALL BEARINGS THAT HELP
THE NEW XC-142A TAKE OFF STRAIGHT UP**

The XC-142A — the first U.S. V/STOL aircraft scheduled for operational evaluation can take off straight up at 5500 to 7500 fpm. Fafnir Duplex Thrust Bearings in the propeller gear boxes help lift the plane's 20-ton-plus loaded weight.

Fairfax engineers applied advanced computer analysis in engineering these bearings for high capacity. SA63210 consumable electrode vacuum melted steel assures optimum reliability in the high-thrust bearing. The smaller flanged bearing is designed to absorb the lighter reverse thrust loads. Both bearings are MLI counterbored type with low-friction, high strength, silver-plated iron silicon bronze retainers.

If extra-critical bearing applications pose problems for you, find out how the "computer approach" at Peter assures reliability. Remember, "Failure on your bearings means sound engineering, highest quality, full value at a fair price." The Peter Bearing Company, New Britain, Connecticut.



Feltair Supplies Bearings take inward axial thrust in each of the four turbogenerator gear box assemblies of the AC-100A. Bearings are heat treated for dimensional stability at operating temperatures.

FAFNIR
BALL BEARINGS

It is considered appropriate to highlight the chosen writing during the visual materials.



BETTER WAYS TO SHOOT THE SHOOTS

Whether you're in the "air quality" in the laboratory or in orbit, these cameras and accessories can provide accurate answers to your short instrumentation requirements. The gas cameras shown below are ideal for primary evaluation in field surveys or other areas. For standard or quantity equipment, 60mm or 35mm, count on Triad for a reliable answer fast. All units shown are available, NIST traceable.



和算一章通解人面鏡三

EXP. ELEC. 1200705.
One model 1200-2100, made by Deltrol, consisting of three, one-half wave stage, one half wave modulator, one half wave detector, and a phase shift to measure light levels and to compare the total output. It is ideal for applications where constant control is required. It has three ranges and memory. Phase and memory switch can also select any range. One model 1200-2100. Input current of 12-20 mA. Output current of 20-100 mA. 280-1440. The current of 20-100 mA has equal qualities.



卷之二十一

To 100 BRITISH H BEECHES
The records presented appear to range at least from 1930 to 1960. The number of trees as shown are one tree or more than one tree on each plot. At 100 Beeches there is no record of a tree larger than 100 cm dbh. At 100 Beeches there are many more trees, with the stem girths showing a greater range than 100 Beeches. At 100 Beeches there are many more stems with dbh less than 10 cm, probably due to the smaller area covered. At 100 Beeches there are more stems with dbh less than 10 cm, probably due to the smaller area covered.



第二章-数据处理与分析

VERSATILITY This versatile little device adds numerous valuable features to your photo album. It's simple to use, yet it can hold up to 100 pictures. It's designed to fit the top of any standard photo album. It holds 100 frames per second in the photo album of your choice. It's made of plastic materials, easy to open, close, clean and store. It's a great addition to any photo album. It's a must for anyone who wants to add more variety to their photo albums. It's a great way to keep your photos safe and secure.



■ 論文摘要 ■

It's time to move this issue to the left front page of the magazine. What good are books, movies, and art if the job or income is the same? We can't afford to let our culture deteriorate any longer or experience meaninglessness. We must insist that we are unique enough to have a meaningful position independent from the mass media. Individuality. Individuality. The need for a sense of personal independence, integral to our

Want some advice?
Trust us, we'll keep your privacy.



TRAD CORPORATION
12120 Belvoir Rd., Silver Spring,



You just won this argument...

□ □ No matter how provocative the issue, this group always agrees on one thing: the best solution to your space power system problems. Their multiple capabilities are dedicated to a single purpose—optimizing your power subsystem specs in the early stages of your aerospace system development.

□ □ These are the kind of specialists ITT can send right into your plant to plan and specify—to help you right from the beginning of your program.

□ □ Among the top members of ITT's technical staff, shown here debating a fine point on the mating of solar panels to inverters, are (left to right) Siegfried Ledene, Director of Research on Power Conversion for the ITT

Space Power Group; Frederic E. Feller, Director of the Power Sources Laboratory; Robert L. Hansen, Senior Member of the Technical Staff; and Robert B. Beitz, Manager of the Space Power Group.

□ □ Look to ITT, the International leader in communications, for static power conversion capabilities. Call or write today.

POWER AND SPACE SYSTEMS DEPARTMENT



INDUSTRIAL PRODUCTS DIVISION
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
1000 Broadway Street San Francisco, California TR 1-5151

WHAT MAKES "INSTRUMENTATION CABLE" DIFFERENT?

It is an argument power or control cables have. That it's better to use a Teflon® or like the old family saying. Not knowing this can cause you a lot of grief: project delays, costly replacements, malfunctions.

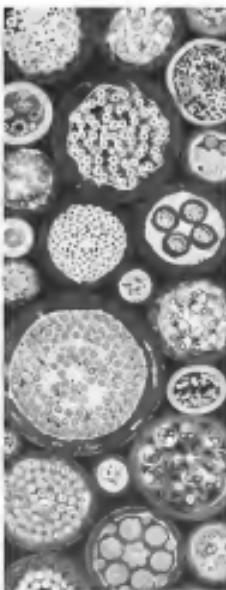
THE THIN BLACK LINE. On your schematic, instrumentation cable is a black line from launcher pad to blockhouse or from one part of a computer to another. In the broadest sense, it carries data at some source, via display or recording or control devices. Its function is to carry those signals faithfully and with the required reliability. In this day and age, it's no easy job.

WHAT CAN GO WRONG. The improperly designed cable can simply fail. This has happened and it's happened often. An unshielded, flat or linear or compound strand used in the cable may destroy the electrical integrity of this primary insulation. Thin wires of different diameters will not be stable, only experts know which configurations will integrate in a meaningful way.

Or a relative lack of art or knowledge may even predict problems for the future. Under certain circumstances in variations in insulation thickness, conductor placement, or conductor configuration in the cable, frequency can cause spurious or ambiguous signals to arrive at the display, recording or control panel. Your sharp pre-test pulses become displaced in time, are a little louder than they were, or by other unwanted signals from another source.

DESIGN IS HALF THE STORY. Configuration of conductors within the cable is important, for physical as well as for electrical reasons. For example, positioning of control components within the cable is critical in order to assure maintenance of minimum standards of interoperability between the three units associated with where the cables may be subjected to bending operations during installation work.

Selective shielding, filter and



insulating materials requires expert knowledge and judgment. Some materials, as mentioned above, tend to migrate. Others harden or soften in cold or heat. Some change their electrical characteristics in time. These are just fundamental new problems in cable design, but an answer is now easier than ever before.

MANUFACTURE IS THE OTHER HALF. Even a properly designed cable may not be completely acceptable because later it will be manufactured to some standards of protection. This requires withstand characteristics that reduce circuitry susceptibility to atmospheric low voltage and helps insure reliable, trouble-free operation. It also requires considerable precision and highly precise cabling equipment. It also requires, as is so often the case in precision installations, an indefinable skill on the part of machine operators.

ASK THE EXPERTS. To protect the know-how of your system, there's only one way to make use of the thin black line on your schematics because cables with all the right properties are only those designed by experts, in consultation with you, and constructed by experts.

Rome Alex is, doubtless, one of the very few companies that qualify. We've been designing and manufacturing these cables for years. If you're interested in what you're going to need, instrumentation cable soon call us, the sooner the better.

We now have a 24-page booklet titled "Instrumentation Cables: Cable Assemblies and House-Wire." In it we describe instrumentation cables and applications, materials, ordering specifications and our qualifications. For your copy, write Rome Cable Division of Alcoa, Dept. 26-81, Rome, N.Y.





1953 target: vehicles on a highway



1963 target: vehicles in space

Thirty years ago, Westinghouse engineers in East Pittsburgh built the radio waves from the pink soil and debris that makes a block move. They didn't call it "radar"—the word hadn't been invented yet.

Radar development at Westinghouse has traveled many paths since 1953. Our laser Center scientists have consistently pioneered in advancing the art-from the rooftop experiments to detecting enemy

airplanes approaching Pearl Harbor to tracking vehicles in space.

Carrying Westinghouse leadership in radar research and development principles gives a unique capability for the future. It is a capability to be reckoned with in any serious discussion of advanced radar systems. Write to Westinghouse Electric Corporation, P.O. Box 988, Pittsburgh 30, Pennsylvania. You can be sure if it's Westinghouse.

Westinghouse

We never forget how much you rely on Westinghouse



...comes through head heat unscathed!

Higher and higher recording speeds mean instrumentation programs—and problems.¹ Increased speed and tension on tape generates friction that concentrates heat around recording heads and can cause ordinary tape unreliable. Signal dropout or distortion can result when the heat and high-temperature build-up separates recording media from tape backing.

"Scotch" brand Heavy Duty Instrumentation Tapes carry signals coolly through head-hot environments. They withstand temperatures from -40°F up to +250°F. They last at least 15 times longer than ordinary tapes. Their heavy duty oxides and binders are formulated to resist heat extremes, mineral oil, and water. Exclusive Silicone Adhesive resists heat wear, tape wear. They offer 1000 times more conduc-

tivity than ordinary tapes to draw off dust-gathering static. 16 different "Scotch" Heavy Duty Tapes are available in 3 series: Polyester backings offered are .05, 1 and 1.5 mils. Choice of coating thicknesses includes 18 and 43 mils. "498" series, excellent high and low frequency resolution. "500" series: smooth, sharp resolution for broad band, other high frequency uses. "909" series: ultra-smooth surfaces for precision recording systems, critical wide band needs.

TECHNICAL TAPE BULLETIN NO. 3 explains temperature effects on recording tape, discusses heavy-duty oxide and binder compositions. Free. Just write 3M Magnetic Products Division, Dept. MCJ-53, St. Paul 19, Minn.



Magnetic Products Division **3M**
MINNESOTA MINING AND MANUFACTURING COMPANY
3M COMPANY
ST. PAUL 19, MINNESOTA
GENERAL OFFICES: ST. PAUL 19, MINNESOTA
MANUFACTURING PLANTS: ST. PAUL, MINNESOTA; BLOOMINGTON, ILLINOIS; CHICAGO, ILLINOIS; CINCINNATI, OHIO; NEW YORK, NEW YORK; PHILADELPHIA, PENNSYLVANIA; WILMINGTON, DELAWARE; BOSTON, MASSACHUSETTS; TORONTO, ONTARIO, CANADA

RAYTHEON

advanced design KLYSTRONS

Is your project the design of dependable ground or airborne radar systems...or equipment for aerospace guidance and navigation? If so, consider the many reasons why you, too, should design around Raytheon klystrons.

To name a few: ultrawide noise, long operating life, highly stable electrical characteristics, exceptional frequency stability, reliability, long shelf life due to hermetically sealed vacuum envelopes. And for airborne types, solid-potted lead frames to eliminate high voltage leakage, small case, lightweight and rugged construction.

Ask your Raytheon Sales Engineer for data on specific klystrons for service as - X-band low-noise end filters - X-band power amplifiers - Ku- and K-band dielectric-tuned oscillators; Dr. microwave. Raytheon Company, Microwave and Power Tube Division, Waltham 54, Massachusetts.



RAYTHEON

Volume 79
Number 9

Aviation Week & Space Technology

August 26, 1968

EDITORIAL DIRECTOR Robert M. Morris Jr.
Editorial Staff Robert P. Hall

MANAGING EDITOR William Gregory

TECHNICAL EDITOR Edward Clark, L. J. Kelly

Peter West, Irving Weiss

EUROPEAN EDITOR Goff-Priestley

FOREIGN CORRESPONDENTS

JOHN R. BROWN, Paris, France

FRANCIS J. CAVANAUGH, Rome, Italy

RONALD D. COOPER, London, England

JOHN R. DODD, Los Angeles, Calif., U.S.A.

JOHN R. FERGUSON, Ottawa, Canada

JOHN R. HARRIS, London, England

SPACE TECHNOLOGY

DOE ARROWS CURTAILMENT OF SOLAR WORK ...

7

SAN MARCIO SATELLITE TO FROZEN AIR DENSITY ...

16

Wettinghouse to Study Lower Powerplants ...

16

Dyne Corp. Gemini Fund Change Bought ...

19

Saturn, Centaur Launches Slip ...

20

Three 2 Miles Successful Flight ...

21

AIR TRANSPORT

NORTHEAST DECISION SETS NO PRECEDENT ...

22

DLXES FACES STRUGGLE TO PROVE DESIGN ...

22

SAC 111 Makes Modern Flight ...

22

Transairbus Case Delays Creates Foreign Competition Delays ...

22

Airport Art Strikes Small Peril ...

23

U.S. Scheduled Service Load Factor-Jan-June, 1963 ...

23

U.S. Scheduled Service Traffic Growth-Jan-June, 1963 ...

23

Airlines Income and Expenses-May, 1963 ...

23

Airline Overview ...

23

Shortline Airline ...

23

AERONAUTICAL ENGINEERING

SEVEN PER MONTH C-141 PRODUCTION PLANNED BY 1968 ...

30

Pursuit's Role in F-105 Avrofied Dayload ...

34

Production Briefing ...

34

MATERIALS

JOINT CHIPS FIGHT AMMUNITION SLASH ...

26

DETAILED TEST AND INSPECTION LEADERS TO BACK NUCLEAR TREATY ...

28

Military Chips Give Way to Treaty ...

29

DRILLING TO MINIMIZE BREAKAGE IN MILITARY ...

29

K-111 Self-Assembly Monitored by Computer ...

29

Automotive Companies Report on Sales ...

29

Defense Sources Urge in Production Control ...

42

Industry Overview ...

29

What's Wrong ...

29

AERONAUTICS

MACHINE THAT 'LEARNERS' MAY BE RECOGN AID ...

44

Fiber Canner ...

47

New Aerotek Products ...

47

AEROSPACE

INTERSTATE AIRLINES SEEKS U.S. MARKET PENETRATION ...

98

FRA Evaluating Eightplane Thorntanders ...

107

EQUIPMENT

THURSTON VECTORIZING MONITOR DEMONSTRATED ...

115

Washington Roundup ...

35

Aerospace Calendar ...

35

News Digest ...

37

EDITORIAL

Other Side of the Coin ...

21

COPPER-Silicon CR-2C (S-111) nonresistor helicopter, chosen by USAF as its long-range support helicopter (AW, July 19, p. 20). It is a production and scheduled for delivery in operational units in October. Helicopter's range testing flew at 6 H. I. in with a 6 ft. 3 in. high. Flight was 25 H. I. in total. CR-2C is powered by two General Electric T53-LB turboshaft engines and has a range of 812 mi. with a 2,000-lb payload.

PICTURE GALLERY

Cover—See 20th Anniversary AW (July 29, p. 20, 21). This Lockheed Super Constellation, the first aircraft to fly around the world nonstop, has been converted into a mobile laboratory for atmospheric research. It is being used to study the upper atmosphere and the effects of atomic weapons tests on the upper atmosphere. Photo—U.S. Air Force.

Member AIAA and AFSC

11,218 copies of this issue printed

Other Side of the Coin



No one believed us!

Sometimes a narrow outswims a whale!

No one thought our small dc motors could do all we claimed. So we give them away for trial.

We were the only people not surprised when our motors performed exactly as claimed.

The problem was the inherent inaccuracy of a conventional gov. armed motor that couldn't be adjusted in flight. Had to be

grounded and re-calibrated quite frequently. Was bulge! Heavy!

We fished around, and came up with a while of a charronetic motor. It was half the size and weight! Adjustable if necessary! Needed little or no maintenance. Did everything the larger motor did—and better! Unusual! Not at The A. W. Haydon Company!

Our only concern is with time—and timing devices. We're confident of

any product we make. We take pride in giving others the same confidence in us—and in our products.

Do you have a time problem?

We have a timely solution!

AWHAYDON COMPANY
Electromechanical Components

THREE DEPARTMENTS FOR QUALITY: DESIGN, MANUFACTURE AND DESIGN CONSULTATION. IN THE EVENT OF LOSS, WE OFFER A 10-MONTH GUARANTEE AGAINST DEFECTIVE MATERIALS.

(For the first time in National Appropriations and Space Administration budgets, it is moving away from language in the budget. Last week, a House appropriations subcommittee headed by Rep. Alben Wm. Thomas (D-Calif.) began an even more thorough scrutiny of NASA's Fiscal 1964 requests than other congressional committees have made (see p. 25). The degree of support in some parties for the critical approach is well illustrated by a recent public letter from Thomas J. Racine, legislative manager of the U.S. Chamber of Commerce to Raja Thomas calling for \$1.2 billion cut in NASA's \$3.7 billion request. To argument in regard with the kind of opposition the space budget faces AVIATION WEEK & SPACE TECHNOLOGY presents except from Mr. Racine's letter.)

The Chamber of Commerce recommends that the \$1.2 billion NASA request amount be reduced by \$1.2 billion and that a total of \$4,512,000,000 be appropriated for NASA programs for Fiscal 1964. We believe this amount will adequately provide for a continuation of our national space program and will enable the space agency to meet the established goal of a manned lunar landing by the end of this decade. The amount we recommend will give the space agency an appropriate 25% increase in appropriations over Fiscal 1963, which is the maximum growth rate we believe can be sustained and supported within the economy as well as scientific and technical capabilities of the nation.

There is reason doubt as to the ability of NASA to spend wisely or properly manage the proposed increases in new obligation authority and expenditures. The National Defense Committee of the Chamber, after a careful analysis of the requested budget concluded that if approved, the proposed increase might actually impede our present space efforts. Evidence submitted to the Committee indicates that there are not enough highly qualified scientific and technical personnel available, either through a crash program which might well entail actually reducing the science resource, to carry out the accelerated program envisioned in the Fiscal 1964 budget.

Since May of 1961, NASA has received virtually everything it has asked in the way of financial support. The congressional and public support was largely due to test elements and because it was necessary to start a number of programs essential to establish goals and to working the so-called international space race. A significant portion of the overall program, Project Mercury, has been completed and we are well on the way to the next stage which will culminate in Project Apollo.

Although detailed information was not available, chamber committees have made a thorough analysis of the authorizations hearings and reports of both the House and Senate.

Several areas of additional savings that we recommend for your consideration include the following:

- Lack of coordination in the Space Program—Hearings on the NASA authorization bill brought out a definite lack of coordination and cooperation among the various agencies of the government in areas of mutual interest

related to the space program. Also of concern is the lack of communication between agencies having similar research and development programs in the field that duplication of research effort and facilities is virtually impossible to overcome or eliminate. The Appropriations Committee should examine similar research programs for evidence of duplication and refuse to appropriate funds for operation of such programs . . . [especially in the area of aerospace medicine . . . [and] human factors systems]

Prominently the best single example of duplication of effort occurs in the field of meteorological research and development. Of the 14 agencies involved in weather research, NASA, the Weather Bureau, the National Science Foundation, and the Department of Defense were all found to be involved in basic research.

• Construction and Use of Facilities—Because construction of facilities must necessarily depend on approval of programs and projects for which they are required, we do not make any specific recommendations for reduction in the appropriations request. We do believe, however, that the Independent Offices Appropriation Subcommittee should carefully scrutinize each request to determine if it is justified.

• Electronics Research Center—We believe the additional participation requested in the House Science and Astronautics Committee to be the maximum measure before any funds are appropriated for the Electronics Research Center. We note that the Senate Armed Services and Space Committee deleted the requirement for jurisdiction of the proposed Center and request only additional information on the location. We cannot support that position and urge that the Appropriations Committee not appropriate funds for the Center until the cognizant congressional committees have received the information requested by the House and have submitted their findings in NASA.

• Administrative Operations—A major portion of this segment is for personnel compensation and personnel benefits to pay the salaries of a year-end total of 32,500 persons. This represents an increase of 3,935 positions over those authorized in Fiscal Year 1963. Every effort should be made to limit further increases and we would hope that the appropriations committee could find ways to reduce further this amount.

• Facility, Training and Research Costs—it is high time that Congress took a long look at the proliferation of federal programs in the educational field and the tremendous increase of federal expenditure. At the present time, there are more than 50 government agencies with subsidies for educational programs with no means of coordination to insure that training appropriate to our country's needs is pursued.

The \$36 million authorized by House action will enable the space agency to continue its current program of facility, training and research grants and would result in a leveling off of the program which threatens to increase further in subsequent years.

LOW COST ADC's

with accuracies to 0.01%
and conversion speeds to 20,000 per second



Here is a whole family of new
high performance/high speed Analog-to-Digital Converters
designed to fit the requirements of virtually all data acquisition systems.

ASTRODATA Series 2000 Line of Analog-to-Digital Converters offers you 1000 standard resolution models produced from a library of 13 basic input cards. From these, you can select full scale range, speed, accuracy...sample-hold-held, reversible output format to meet your specific requirements.

Where highest speed is desired, decisions are made in the use of 2.5 microseconds per bit, yielding 20,000 or more conversions per second for 10-binary bit converter. Where max-

imum accuracy is required, a basic accuracy of 0.01% is provided with decisions made at the rate of 4 microseconds per bit, yielding approximately 13,000 conversions per second for 14-binary bit converters.

Especially suited for use with time-multiplexed input data, Series 2000 ADC's provide high speed, ultimate reliability and modular plug-in construction in one compact package...maximum value for your instrumentation dollars.

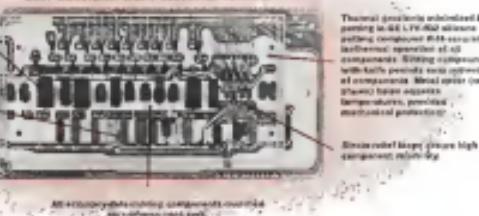
HIGH RELIABILITY ASSURED BY DISCUSSION OF CONSTRUCTION AND CONVENTIONAL COMPONENT DIS-RATING

Reliable references are provided:
to >0.001% for all accuracies;
determining loadlines from
temperature limitations
and to >0.001% for
RMS noise characteristics.

Series 2000 pre-wired and
interchangeable modules designed for 1000
hours per year at 10,000°F (537°C),
and for 1000 hours per year at 1000°F (537°C).
Interchangeable modules have
2000 hours 800°F (427°C) and over
1000 hours for 600°F (316°C)
maximum operating temperatures.

Integral circuit design
reduces number of discrete
components, enhances reliability.

MOST SIGNIFICANT DATA CONVERTER NETWORK



Contact your Astrodata engineer
for more information or to request
a free copy of the technical literature
giving complete specifications.



ASTRODATA, INC.
581 EAST PALM ROAD • ANAHEIM, CALIFORNIA • PHONE (714) 753-1029

18

WHO'S WHERE

In the Front Office

William A. Key, board chairman, and
George R. Bryant, president, UTRG General
Contractors, Inc., Clarendon Hills, Ill.

Seated B. Koenig, vice president and
general manager, Pan American World Airways, Inc.,
and W. Woods Lyford, vice president,
communications. Also John G. Roger, chief
negotiator and Eddie Sherman, assistant vice
president.

High Boughner has joined the board of
Harbor Selden International Ltd., London,
England, as director for aviation and
responsible for sales and distribution operations.
John Roe has been promoted to
the board of Hawker Siddeley Holdings Ltd.,
and will assist the managing director.

George Ingram, Jr., a senior vice president,
Bathurst Co., Lexington, Mass., and
a director. Mr. Ingram is the company's
chief financial officer.

As Vice Marshal I. G. Coulthard (RCAF,
ret.), a vice president of Canadian Ltd., is
in charge of European Operations with offices
in London, England.

William F. Dales, vice president-financial,
Avco Corp., Woburn, Mass., Massachusetts
Attala V. Sankaran, president of Pan
American-Gates Airways, Inc., will head
the operations department and assume total
all supervision of the Miami office.

J. P. Chambers, corporate secretary, Mid
West Inc., Falls Church, Va.

James D. Wright, former group vice presi
dent and a director at Ford Motor Co.,
has been named a consultant to Litton Indus
trials, Beverly Hills, Calif.

Honors and Elections

The Mackay Trophy has been presented
to the crew of a Strategic Air Command
B-52 bomber for its record flight of May 5,
1962, which established a new Los Angeles
to-New York flight record of 8 hours, 10 min.
The crewmen are: Mr. Robert G. Scott, aircraft
navigator, Capt. Robert Madole, pilot,
navigator, Capt. John T. Wilson, ele
ctronic countermeasures operator.

The Air Force Systems Command Award
for Outstanding Achievement for developing
the first operational space station has been presented to the following
team of engineers from Hughes' Space
systems Div. and Military Products Group,
Research Dept.: Walter Egl, Richard A. Evans, Louis J. Gorito, William J. Lewis,
David L. Poore and Richard J. Rollins.

Changes

Isaac E. Walensky has joined the staff of
Spartan Optoelectronics, Inc., Pasadena,
Calif., as a senior vice-president and general
engineer. Also Edmund M. Degnan,
a senior vice-president, systems develop
ment operations.

Dr. M. Stewart White, Federal Art Ser
vice, FBI, Washington, D. C., has been named
Rapier Captain. His team, based at
FBI-Baltimore, field mechanics, of Lockheed
Missiles & Space Co.'s Mechanical and
Mathematical Sciences Laboratory, Pat
Alto, Calif.

(Continued on page 120)

INDUSTRY OBSERVER

► Negotiations for a \$15-million B-52K modification program are under way at Ogallala Air Materiel Area, Hill AFB, Utah. Approximately 40 aircraft, like the model being modified by On Mark Engineering (AWW July 18 p. 66) would be purchased for counter-seasickness (COIN) rescue missions. Several companies besides On Mark are bidding on the program.

► Sikorsky CH-18 (anti-submarine helicopter) will be demonstrated to USAF's Air Rescue Service at Orlando, Fla., Aug. 25 in a possible rescue and recovery vehicle for the service. Air Force has ordered the CH-4C (S-65) anti-submarine version (see cover) as its long-range support helicopter (AWW July 8, p. 22), and some of these helicopters may go to ARS (see p. 99).

► Avco Fawcett, among contractors, possibly Pacific Air Force, have planned experiments for 90-90 Fairchild C-130H conversions, using General Electric J57 turboprop engines on wing pylons in addition to the Pratt & Whitney J58s now being used. Propulsion and operating costs, the source for such a modification program, are heavily committed to the B-52 modification program for fiscal 1968 (see below).

► Hawker Siddeley is negotiating with Atlantic Aviation Corp. and Air Rescu
e Service Air Service Co. for sale of the de Havilland DH-105 executive jet in the U. S. Meetings were scheduled in this country over the weekend, and an agreement may be announced this week.

► Part of the next batch of 16 de Havilland Caribou transports is expected
to be flown from Canada to India in September. Since the start of the
South-Indian conflict last October, Canada has supplied India with eight
CH-13s, five Otters and 36 Hawker Siddeley. This continues its best-made
available partly as an outright gift and partly on loan at reduced interest.

► Countermeasures research appears to be necessary before VTOL
aircraft, such as the tiltwing, Long-Range-Vought XRC-142A, would be
perfected to operate from pads located inside cities or other densely populated
areas. Helicopters are said to be popular since levels generated by the
XRC-142A on takeoff would be similar to a Concorde on takeoff.

► Development of photostatic materials to produce visible images almost
instantly after exposure will be sponsored by Air Force's Astronautical
Systems Div. The technique, in which cells receive no wet chemical processing
would be designed to provide an image for airborne assessment within 5 sec
after exposure. Proposals are to be submitted by Aug. 29.

► Range safety studies conducted at both Atlantic and Pacific missile ranges
suggest that if the present restrictions on boost vehicle launch azimuths at
both bases was lifted, the hazard to populated areas in the U. S. would be
no greater than that caused by jet transport operations. The limits of launch
azimuths have imposed severe restrictions on many U. S. space efforts.

► Modification programs for USAF's Boeing B-52 bombers will taper off at
the current fiscal year, in which \$108.9 million was requested for completion
of 18 changes ranging from structural healing of the wings to automatic
checkout equipment for the electronics system. Most active year of the
modification program was fiscal 1962, when \$20.9 million was asked for
initially and another \$10.9 million was requested later. In fiscal 1963
\$11.2 million was requested. That total requested for the three years was \$57.45
million.

► Federation Aeronautique Internationale has certified as a world record the
speed of 253.815 kph (157.6 mph) set last May by a Russian MiG-21
MiG-21 fighter over a 300-km. closed course. The Soviets had claimed a
speed of 161 mph for the MiG-21. Previous record for helicopter in the 1,750-
3,000 kg. (3,684-6,699 lb.) class was 142.1 mph set in 1960 by an Avia-Bell
UH-1 transport.

Washington Roundup

Perilous Passage

In all of its perils passage through Congress since hearings began last February, National Aeronautics and Space Administration's \$5.7-billion budget request has survived nothing like the rough treatment it's getting from the House Independent Office Appropriations Subcommittee. Chairman Rep. Dr. William H. Gray, director of the Marshall Space Flight Center and Dr. William P. Fahey, head of the Jet Propulsion Laboratory—campaigned from the subcommittee a closed hearing but were nowhere to be seen at the experience.

Present House Appropriations Committee probably will recommend a NASA budget for fiscal 1964 of about \$5.2 billion. The Senate Appropriations Committee is expected to vote a \$5.4- or \$5.5-billion budget and the appropriation will have to go to a House-Senate conference committee for resolution.

This is what happened to legislation which authorizes NASA spending for fiscal 1964. The House approved a \$5.2-billion measure and the Senate \$5.5 billion. For a while, it looked as if conservatives Republicans would succeed in a legislative amendment which would have forced the House members to hold off, for a \$5.2-billion authorization (AW Aug. 19, p. 25). Rep. James Fulton (R., Pa.) and his succeeded in convincing the House Republican leaders that this would have cost the government a \$100-million cut.

Although the authorizing bill recommended by the conference committee probably will come out at about \$5.4 billion, the real threat to the NASA budget is to the House Appropriations Committee. Right now it looks as though NASA won't end up with an appropriation of more than \$5.2 or \$5.3 billion.

Soviet Space Flight

U.S. space scientists, who have never taken Sir Bernard Lovell's pronouncements on the space race too seriously, are even more skeptical of the British astronomer's statements that the Soviet Union may have canceled or slowed down its manned lunar landing program. In advancing the first anniversary of the Vostok 1 and 4 group flight (AW Aug. 30, 1962, p. 26), Soviet officials said their manned flight program would lead to landing cosmonauts on the moon. This Soviet Gen. N. N. Kamanin said last week that cosmonauts Yuri Gagarin and Gherman Titov are preparing for a flight "very soon."

While M. Hawkins, Lockheed Aircraft Corp.'s vice president for science and engineering, is considered a leading candidate for assistant secretary of the Air Force research and development, a post vacated recently by Fred J. Ladd,

Supersonic Transport

Selection of Eugene R. Black as a special adviser to the President on the financial aspects of the supersonic transport (SST) (AW Aug. 19, p. 37) without consulting N. E. Hubble may indicate when, where, and attachment with the FAA administrator's leadership in the SST program. Hubble received word of the appointment only shortly before the official announcement was released to the *Bureau* Press.

Black's prior function is to evolve a program which will soften industry opposition to a supersonic transport. He will also advise the President on the financial aspects of the SST program.

In an effort to keep abreast of the British and French in the supersonic transport race, the FAA last week took the unprecedented step of sending 21 foreign flag carriers to hear a sales pitch on the U.S. project. Gordon M. Bern, FAA deputy administrator, stressed U.S. experience in building supersonic military aircraft and the construction of safe and profitable commercial planes. He also reiterated safety claims that the U.S. is not far behind the British/French Concorde program.

Happy Birthday to Me

Aerospace Industries Assoc., The American Institute of Aeronautics and Astronautics and the Aviation/Space Writers Assn. have announced that will sponsor a \$150-prize fifth anniversary dinner for NASA on Oct. 5—in response to a polite and subtle suggestion that originated within the aerospace agency itself.

Friends of Lt. Col. John A. (Shane) Powell have enlisted the help of Rep. Albert Thomas (D-Tex.) to make sure that NASA pays Col. Powell in charge of the agency's \$600,000 1964 World's Fair exhibits and educational programs. Col. Powell can pocket all the agency ridiculous he would have the World's Fair job to soften the blow of his removal as director of public affairs for the Manned Spacecraft Center, but that the agency now wants to give him a less attractive job.

—Washington Staff

Perfect gyro. Spin a globe of homogeneous fluid and it is instantly in balance... becomes a perfect gyroscope. Sperry has applied this principle to produce the SCV 300 Fluid Sphere Gyro... an instrument with high accuracy and reliability at low cost. The spinning liquid mass, replacing the conventional rotating wheel, can detect motion changes smaller than 1/1000 of a degree per hour. It has less than half the parts of conventional gyros — no high-precision parts. It warms up quickly, without a heater, can be stored and operated from -85° to +200°F. This two-axis gyro, from Sperry's fluid gyro series, can serve as an inertial platform, as a rate gyro, for tactical missile guidance or autopilot control. Can this "perfect gyro" help your project? INERTIAL DIVISION, Sperry Gyroscope Company, Great Neck, N. Y.

SPERRY
DIVISION OF
SPERRY RAND
CORPORATION

Joint Chiefs Fight MMRBM Fund Slash

Gen. Taylor says allies are "intensely interested" in program, urges that \$100-million cut be restored.

Washington—Joint Chiefs of Staff last week publicly took issue with Secretary of Defense Robert S. McNamara and urged the Senate to restore a \$100-million House reduction in the mobile midrange ballistic missile (MMRBM) program—probably the most controversial aspect item in the fiscal 1964 budget.

Deputy Secretary of Defense Russell L. Gilpatric told the Senate Defense Appropriations Subcommittee that he and McNamara considered the reduction acceptable.

Gen. Maxwell D. Taylor, JCS chairman, challenged that. He told the subcommittee the cut would delay ultimate operational induction of an MMRBM system by 1 to 1½ years. This would lose \$100 million for Fiscal 1964. This would be applied to the development of guidance, command and control aspects.

In seeking the \$100-million cut, House Appropriations Committee noted that less agreement on deployment date not yet been made with North Atlantic Treaty Organization (NATO) countries and suggested that Army's Pershing and Navy's Polaris missiles be retained for the MMRBM system (SW July 1, p. 34).

"Our NATO allies are extremely interested in the outcome of this program," Gen. Taylor told the Senate subcommittee. "They have asked us to regard our MMRBM as essential to replace obsolescent aircraft and missiles assigned to the attack of targets of prime interest to NATO." The proposed reduction of funds will be squared with appropriations and will be integrated to some in an reduction of our reduced concern for the requirements of the defense of the NATO area."

It was disclosed at the hearing that Defense Dept. has agreed to accept or cut \$1 billion in the \$2-billion reduction made in the fiscal 1964 budget by the House. This is a notable departure from the stand firm resolution of previous Defense Dept. administrators in defense spending budgets in Congress.

The House rejected Defense's request

that is necessary as to some of the electronic components, there is absolutely no question with regard to the Marine Corps' requirement for an improved reconnaissance and electronic warfare capability."

+ Lockheed C-141, \$25 million. The House two objectives were a \$100-million reduction in Air Force aircraft procurement and a \$15-million cutback from Lockheed Aircraft Corp.'s anticipation of profits from future commercial sales. Gilpatric discounted the possibility of either of these objectives. He said Lockheed's commercial sales would not start until about 1966, and that at this point it is impossible to estimate what the profit from them might be. The effect of the \$15-million cut, he said, would be a reduction of three aircraft in Fiscal 1964. "This devalues the buildup of test and capacity which we deem so crucial to our long-term capabilities."

■ **Mechanics RF-4C, \$25 million.** The House recommended a \$25-million cut-down in the USAF's second-generation Phantom II aircraft program so that uncertainties in its electronic systems could be resolved. Gilpatric maintained these risks and uncertainties of the reconnaissance force is "a most urgent problem" and that reinsurance is one the heating factors in its interest in support of ground forces.

■ **Lockheed F-100C, \$16.2 million.** The House made this reduction to eliminate fragmentation. Gilpatric stressed agency's understanding of USAF's need to keep the F-100C in service at least as a interim fighter until reliable fighter replacement becomes feasible later down the road, the initial long-range weapons aircraft she receives, he said.

■ **Navy fighters, \$21.9 million.** Gilpatric called for restoration of \$1.2 million for the Common Griffon navigation system, and \$11.7 million for North American Aviation T-2B jet trainers.

■ **Communication satellite, \$44.6 million.** Gilpatric accepted \$15 million of the \$76-million reduction made by the House. The \$94.6 million, he said, is needed to develop a communications satellite \$50 million for Fiscal 1964.

■ **Frigate-Vegetal Launch Missile, \$10.5 million.** The House said the missile could be developed for \$1 million but at the contractor's plant of Dallas, Tex., this is the proposed Army facility at White Oak, Md. For the short run, this is true, Gilpatric said. On the long run, one of the Warren facility will bring savings because it has about \$11 million worth of special materials and tools that can be used for future Gilpatric said.

Westinghouse Lunar Powerplants Study

Washington—Lunar Corps of Engineers has begun negotiations with Westinghouse Electric Corp. for funds and conceptual designs of a nuclear powerplant and space fuel system to support a manned lunar base. Value of the two contracts which will not be monthly will be about \$500,000.

The powerplant is estimated at a single Sabre N-5 rocket capable of being developed and launched by 1972. Westinghouse will study and determine the potential of several approaches during the first few months. Then a decision will be made on which approach will be chosen.

The contracts are being managed by the Corps of Engineers for the National Aeronautics and Space Administration. Ten companies bid on each of the projects

Dyna-Soar, Gemini Fund Change Sought

Washington—Defense Dept. has asked congressional authority to shift up to \$125 million now authorized for Dyna-Soar or March 3 aircraft programs to Air Force's participation in the Gemini program.

This proposal, \$20 million in defense funds are programmed for Gemini for Fiscal 1964. The House had originally proposed to be removed \$20 million from NASA funds and add \$20 million to Air Force funds.

A study to expand the program is now under way. Dr. Harold Brown, director of defense research and engineering, told the Senate Defense Appropriations Subcommitee that "it may indicate that *one can do more effective experiments during perhaps with ground and orbital experiments and proceeding to additional Gemini flights. It is, that will require FY64 funds."* He maintained the possibility of two additional Gemini flights that would be all Air Force.

The Defense budget as proposed by the House reduces \$125 million to use as the Dyna-Soar program, the \$20 million as an unknown March 3 aircraft development. Defense Dept. urged the Senate subcommittee to include "space vehicle" in this distinction in the money could be shifted to Gemini.

Deputy Secretary of Defense Russell L. Gilpatric denied a suggestion by Sen. Richard Russell (D-Ga.), the subcommittee chairman, that "Dyna-Soar is now older than the RS-70."

Brown and Air Force strongly support the Dyna-Soar program but feel more "no choice" between Dyna-Soar and Gemini."

A planning board representing Defense Dept. and NASA (SW July 22, p. 22) has already outlined possible Air Force Gemini flights soon costing in the tens of millions of dollars, Brown said.

whole DOD plan to reduce the program was a political maneuver to gain some of the House-expended cuts. Other sources have indicated that there are technical reasons for a slow down and cutoff of the boosted.

Army General and Thaddeus, the two engineers involved in developing the 156-in. booster, have spent large sums of their own time to argue their preference to a single-stage booster so that the unboosted booster could be transported to Cape Canaveral Fla. for launching. The booster will be too big to move by air and road. Army's plant is in Dixie County, southwest of Miami, Fla. Thaddeus has chosen Camden County, Georgia.

The 156-in. booster can be built in segments and shipped by rail and truck to launching site for assembly.

High level Administration thinking outside of Defense Dept. and NASA is that the large booster will be the best under other program case or situation. This thinking is disseminated rapidly by numerous congressional committees that the unboosted booster will go ahead with both large liquid and large solid booster programs.

The committee also passed favorable liquid propellant proposals against those favoring solid propellants. The committee developed law focused on Capitol Hill but have varied over into Defense Dept. and NASA. During the past seven weeks the Air Force has maintained its position within the Defense Dept. but has made no start moves to its program. The Air Force maintained that it would not move to its program. The Air Force maintained that it would not move to its program.

Deputy Secretary of Defense Ross will L. Calfee and Dr. Donald Brown, director of defense strength and space, Management Board of Defense Dept., will be represented by other agents in DOD/NASA's agreement of Nov. 1962. Pending its being defense officials, as this wrote a letter to Sen. Richard B. Russell (D-Ga.), chairman of the Senate subcommittee, presenting the cuts and saying that NASA needed the knowledge to be gained from the program.

Dr. Brown's proposal, as an informal memorandum dated Aug. 19, that \$16 million should be requested to continue development of the 156-in. solid rocket and that the 156-in. tests be discontinued indefinitely.

Two days later, before the committee, the plan was further clarified to include an additional \$15 million for the 260-in. work, with a promise to request another \$12 million in Fiscal 1963.

Both Sen. Russell and Rep. George C. Miller (D-Calif.), chairman of the House space committee, heard at the DOD hearings and threatened to take the whole program away from Defense and give it to NASA.

Some observers believe that the

whole DOD plan to reduce the program was a political maneuver to gain some of the House-expended cuts. Other sources have indicated that there are technical reasons for a slow down and cutoff of the boosted.

Army General and Thaddeus, the two engineers involved in developing the 156-in. booster, have spent large sums of their own time to argue their preference to a single-stage booster so that the unboosted booster could be transported to Cape Canaveral Fla. for launching. The booster will be too big to move by air and road. Army's plant is in Dixie County, southwest of Miami, Fla. Thaddeus has chosen Camden County, Georgia.

The 156-in. booster can be built in

DOD Curtailment of Solids Work Dropped Due to Stout Opposition

By Larry Boorda

Washington—Defense Dept.'s determination to drastically curtail large solid-propellant booster development stalled last week in the face of congressional, intergovernmental and industry pressure.

Deputy Secretary of Defense Ross will L. Calfee and Dr. Donald Brown, director of defense strength and space, Management Board of Defense Dept., will be represented by other agents in DOD/NASA's agreement of Nov. 1962. Pending its being defense officials, as this wrote a letter to Sen. Richard B. Russell (D-Ga.), chairman of the Senate subcommittee, presenting the cuts and saying that NASA needed the knowledge to be gained from the program.

Dr. Brown's proposal, as an informal memorandum dated Aug. 19, that \$16 million should be requested to continue development of the 156-in. solid rocket and that the 156-in. tests be discontinued indefinitely.

Two days later, before the committee, the plan was further clarified to include an additional \$15 million for the 260-in. work, with a promise to request another \$12 million in Fiscal 1963.

Both Sen. Russell and Rep. George C. Miller (D-Calif.), chairman of the House space committee, heard at the DOD hearings and threatened to take the whole program away from Defense and give it to NASA.

Some observers believe that the

tracks were selected last April 17. For one thing, the rounds end up about a 1000 miles apart geographically from each other. The Air Force Space System Division industry studies had not dealt with atmospheric effects and consequent structural problems caused by this configuration.

In addition, a five-stage, 155-in. round will be 170 ft. high. The new or extended reentry Segment lengths probably will have to be cut to optimize the overall length.

These problems will require close scrutiny before any flight test contracts are let. As they stand now, the 155-in. round group essentially are aimed at the same range as the generation of existing ICBMs. One possible approach which has not yet been included in a contract is liquid oxidizers. Both Thorol and Liquidair will have to demonstrate 5 days of vector control with their respective systems. SBD thinking is that liquid injection could not produce a target of that magnitude.

Military need for large solid propellant

long boosters as intercontinental ballistic missiles, has disappeared with the acceptance of nuclear warheads. One Air Force proposal calls for 50,000 lb. of payload. The boosters could be handled by the USAF Materiel Test Board, which is a T-32 crew and one or two upper stages with two United Technology 120-in. dia. solid propellant motors which are strapped to the core.

The atmospheric component categories that were included in the original budget request for Fiscal 1964 sum \$515M, as follows: \$3 million, SR 65IC; Mach 3 target, \$3 million, SR 65ID; liquid propellant cycle (LPC) engine, \$5 million, SR 65IS; aerospace combustion, \$1 million, SR 65IP; test hardware, \$1 million, SR 65IG; advanced studies, \$1 million.

The Senate recommendation of June

proposed cutting all but the Mach 6 intercept funding. Some of the money in the other categories will be酌oted if Defense Dept recommendations call for closed actions of the committee are approved.

Detailed Test and Detection Plans Readied to Back Nuclear Treaty

By Katherine Johnson

Washington—Comprehensive plans for a long-range underground nuclear testing program, establishment of a steady-state regime for atmospheric testing and a major program for development and deployment of nuclear detection systems is being prepared by the Administration.

This work is being conducted by two Senate committees—Armed Services and Foreign Relations—and the Senate is taking an evaluation of the three long-term tests in the atmosphere, space and under water. Underground testing is exempted from the ban.

The Administration plans will implement safeguards which the Joint Chiefs of Staff specified were needed. The Senate Armed Services Committee has asked the Administration to draft specific plans for ensuring these safeguards.

President Kennedy last week assured Congress that "we are going to do everything we can to make sure that what we are going to take to explore the outer regions." The Senate Foreign Relations Committee called for termination of nuclear laboratory facilities during the testing moratorium as well as "concerns over atmospheric migration, and continuing underground nuclear test programs." For maintenance of flexibility and resources "to conduct promptly nuclear test in the atmosphere," and improvement of the capability to detect treaty violations and maintain knowledge of Soviet nuclear

activities, capabilities, and achievements."

Last week's Senate hearings focused on the major issue dramatically raised by Dr. Edward Teller—whether the treaty will give the USSR a decisive advantage in the development and deployment of an洲际弹道导弹 (ICBM) but little missile defense.

During a fall-long session, Teller repeatedly and emphatically insisted that the Soviet Union's system of treaty, he declared, would give the USSR the future safety of the country.

Dr. Melvin Brenner, director of defense research and engineering, who largely outdid Teller's insistence but also the technological and intelligence data on which it was based.

The logic of Teller's contention was that the USSR, during its intensive 1961-62 nuclear test times, obtained enough knowledge to enable the development of an operational ICBM system.

The U.S. does not have comparable operational knowledge and would require atmospheric testing to obtain it, he said.

USSR tests "were minimally designed for scientific dataset," Teller declared. "I do not believe the Russians need any more atmospheric info."

The main conclusion that might be made is that ICBM development by atmospheric testing is feasible, in the blackout of missile communications and radars by nuclear bursts.

U.S. and Russian knowledge on these nuclear weapons effects at a standstill, Brenner said. "We have data they don't have and vice versa."

The part which greatly concerned Senator's position and said that further atmospheric testing is not an essential requirement for development of an洲际弹道导弹 system—although it may be desirable. USAF's chief of staff, Gen. Curtis LeMay, pointed out that none of USAF's ICBMs have been exposed to atmospheric testing—Air Force Materiel Test Board, which is the same "high confidence" in an air ICBM without atmospheric testing that we have on the X-15s, Gen. LeMay said.

Gen. LeMay also requested postponing of the three ICBMs in the 1963 Downey裁量 but his proposal was rejected either in Senate or Defense. Robert S. McNamara or the President's Policy Board would not initial in the Downey vote.

Baking Teller's position, Dr. John S. Foster, director of the Atomic Energy Commission's Lawrence Radiation Laboratory, testified that he "startled" concern is that the U.S. will not be able to test ICBMs in the stress plane.

"Missile systems for offense or defense are extremely complex yet must function and work under the most adverse conditions in which they are normally trained, but also under the most adverse conditions—those of nuclear war," Foster said.

A team of missile systems which have not performed as expected—or have actually failed—when post-tested in environments which are far better simulated than that of a hostile nuclear situation."

Through atmospheric testing, Teller concluded, the U.S. could have an ICBM system that would be effective against the USSR in the next few decades and perhaps eliminate a Soviet atomic war threat to the U.S. for retaliation, but others could not be used and the population would have to go underground, Teller said. He called for a massive fall-out shelter program.

The U.S. might eventually develop a system which could stop increasing numbers from its blackouts, but no such proposal is even being considered by the scientific community now, Teller said.

The Administration has already taken one step to improve its steady results in atmospheric testing, setting up the Inter-Agency Atmospheric Testing Board. The Project 1000 and 5000 miles has been allocated to support Johnston Island in the Pacific. "In fact, atmospheric overflights of it should occur," Teller which are being planned—possibly to be put on the agenda of an atmospheric test session if tests were

continued as intercontinental ballistic missiles, has disappeared with the acceptance of nuclear warheads. The Air Force Space System Division industry studies had not dealt with atmospheric effects and consequent structural problems caused by this configuration.

In addition, a five-stage, 155-in. round will be 170 ft. high. The new or extended reentry Segment lengths probably will have to be cut to optimize the overall length.

These problems will require close scrutiny before any flight test contracts are let. As they stand now, the 155-in. round group essentially are aimed at the same range as the generation of existing ICBMs. One possible approach which has not yet been included in a contract is liquid oxidizers. Both Thorol and Liquidair will have to demonstrate 5 days of vector control with their respective systems. SBD thinking is that liquid injection could not produce a target of that magnitude.

Military need for large solid propellant

long boosters as intercontinental ballistic missiles, has disappeared with the acceptance of nuclear warheads. The Air Force Space System Division industry studies had not dealt with atmospheric effects and consequent structural problems caused by this configuration.

In the field of nuclear weapons, particularly in the field of very low yield weapons, the U.S. is probably ahead in the quality and diversity of systems."

With regard to air superiority—"the ability to inflict damage on the enemy."—the U.S. is present a clearly defined of the USSR in the ability to wage strategic medium war, and is probably ahead in the ability to wage tactical nuclear war, although the Soviet Kirov developed a tactical nuclear strategic missile.

If the treaty is faithfully observed, "the U.S. would not be able to sustain the present advantage which the USSR probably has in the high-yield weapons field, whereas the Soviets probably will not be able to sustain the low-yield tactical field. Both sides could achieve an inter-balance stability, but one with less desirable characteristics than would be the case if additional atmospheric tests were conducted."

Progress from Soviet simulation testing would be "a relatively slow factor in relation to the overall present and probable balance of military strength of integrated airfields are situated."

Conclusion: "While there are military advantages to the treaty, they are not so serious as to render it unacceptable. The lesser advantages... have left the U.S. to conclude that it is appropriate to withdraw from the overall intent of the U.S. and to support the reductions." The remaining major items of the JCNS are more directly linked with the focus of emphasis—the weapons effects. In weapon effects based upon high-yield nuclear explosives and in the yield/weight ratios of high-yield devices and that the USSR

should—an ICBM blackout test and weapons effects sim to determine the effects of surface blast on hardened mobile sites, Borko said.

Defense Dept. and Atomic Energy Commission are now examining ways of dealing with development of a high-yield nuclear weapon. This has long been urged by Air Force Personnel. It would be directed against hardened Russian missile sites. Russia tested weapons up to almost 60 megatons during the 1961-62 series. U.S. has developed weapons only to about 30 megatons but has developed a bigger yield atmospheric testing facility.

On U.S. intention to attack on its own missile sites, Borko said:

"In the future it is expected that financing of advanced U.S. missile systems will be possible with a signal test set done as assault without sending aircraft of the launch control centers or their concentrations to the missile, which will eliminate any effect of vulnerability of launch control centers and control cables."

Borko made the following points about atmospheric tests that Russia could conduct under the treaty and about programs being considered to detect them (AW Aug. 5, p. 26):

Military Chiefs Give Views on Treaty

top priority behind the U.S. at low yields," statement said. "In the atmospheric missile field, development of the U.S. system does not depend on atmospheric testing and hence the treaty will not significantly influence any initiative that may result."

"In the field of nuclear weapons, particularly in the field of very low yield weapons, the U.S. is probably ahead in the quality and diversity of systems."

With regard to air superiority—"the ability to inflict damage on the enemy."—the U.S. is present a clearly defined of the USSR in the ability to wage strategic medium war, and is probably ahead in the ability to wage tactical nuclear war, although the Soviet Kirov developed a tactical nuclear strategic missile.

If the treaty is faithfully observed, "the U.S. would not be able to sustain the present advantage which the USSR probably has in the high-yield weapons field, whereas the Soviets probably will not be able to sustain the low-yield tactical field. Both sides could achieve an inter-balance stability, but one with less desirable characteristics than would be the case if additional atmospheric tests were conducted."

Progress from Soviet simulation testing would be "a relatively slow factor in relation to the overall present and probable balance of military strength of integrated airfields are situated."

Conclusion: "While there are military advantages to the treaty, they are not so serious as to render it unacceptable. The lesser advantages... have left the U.S. to conclude that it is appropriate to withdraw from the overall intent of the U.S. and to support the reductions." The remaining major items of the JCNS are more directly linked with the focus of emphasis—the weapons effects. In weapon effects based upon high-yield nuclear explosives and in the yield/weight ratios of high-yield devices and that the USSR

should—an ICBM blackout test and weapons effects sim to determine the effects of surface blast on hardened mobile sites, Borko said.

Defense Dept. and Atomic Energy Commission are now examining ways of dealing with development of a high-yield nuclear weapon. This has long been urged by Air Force Personnel. It would be directed against hardened Russian missile sites. Russia tested weapons up to almost 60 megatons during the 1961-62 series. U.S. has developed weapons only to about 30 megatons but has developed a bigger yield atmospheric testing facility.

On U.S. intention to attack on its own missile sites, Borko said:

"In the future it is expected that financing of advanced U.S. missile systems will be possible with a signal test set done as assault without sending aircraft of the launch control centers or their concentrations to the missile, which will eliminate any effect of vulnerability of launch control centers and control cables."

Borko made the following points about atmospheric tests that Russia could conduct under the treaty and about programs being considered to detect them (AW Aug. 5, p. 26):

To complement the ground-based



USAFL/LOCKHEED C-141 STARLIFTER (top) overall length of 148 ft., nose to tail, is evident in side view (left). Payload compartment



(right) 31 ft. long. View through rear access door (right) shows size of interior. Doors can be opened in flight for loading of personnel and supplies.

First C-141 Rolled Out; Production Rate

By James R. Ashlock

Atlanta—Production rate for the USAF/Lockheed C-141 StarLifter jet transport is planned to reach seven aircraft per month by 1966, based on the current total military order for 132 planes.

Full scale production at Lockheed-Georgia here will not begin, however, until the first five production aircraft have received dual certification to meet military and Federal Aviation Agency requirements.

Learning from experience, the program manager for the C-141, Lt. Col. James R. Wigand, USAF, says, "We're not going to make the same mistake again. We'll roll out the first five aircraft in the fall of 1964 with the delivery of the sixth plane. The first full squadron will be delivered to Military Air Transport Service (MATS) in June, 1965."

The production contract calls for the first flight of the airplane by the end of the year, and Lockheed officials stress no problems in meeting that schedule. Their optimism stems from the progress being made on schedule to this point.

"The first complete aircraft has rolled out," says Wigand, "and we're not more than two months behind the Lockheed-Georgia plan. The rollout was one day ahead of the contract schedule, which called for the plane to leave the assembly line by the end of August. It was less than a week behind Lockheed's own schedule, which specifically had set the rollout for Aug. 26."

"The contract schedule we bid is so tight that we've stuck very close to it without any extensions of our own," Charles S. Wagner, vice president in

Armed Services Committee, and Rep. Carl Vinson heads the House Committee on Armed Services.

Lockheed's maintenance of the C-141 contract schedule has been aided by the fact that the aircraft has been subjected to only a few design alterations during development. One major change involved the engine. Originally, the Pratt & Whitney JT4D-3 powerplant, with 18,000 lb thrust, was specified. Shift to the PW4 TF33P-7, with 21,000 lb thrust, came after the contract award, but the change caused no delays, since engine availability and testing have coincided with the overall development schedule.

Thrust of an eight-week delay arose early when a forging due for the central fairing was cracked during the casting process. Rugs from the part were needed for the first assembly stage involving the wing root and trailing gear assembly panels. The rug causing the four forged pieces weighing a total of 5,300 lbs.

However, Wigand said, subsequent progress was such that the eight weeks required to cast a replacement did not add up and an on-time schedule resulted.

Overall, the C-141, by weight, was unanticipated (AW, Oct. 9, 1961, p. 56). Lockheed was concerned that such widespread production might result in improper fittings over the varied assemblies when returned to the plant for joining. A decision was

Of Seven Planes Monthly Planned by 1966



CLOSE SPACING OF ENGINES is shown in C-141 forward view. Wings have 11 T-tips, engine cowlings tilted to prevent Dutch Roll. Tops, when idle, are 40 in. below the root, but the 20 in. during flight. Wings are swept back 21 deg.

President's Role in TFX Award Disclosed

By Edward H. Kukens

Washington—Decision to award the F-111 (TFX) contract to General Dynamics was made and was revealed to President Kennedy before Pentagon chiefs had read the fourth and final Systems Source Selection Evaluation Report, which gave an edge in operational superiority to the Boeing proposal but gave General Dynamics a higher total score.

Air Force Secretary Eugene M. Zuckert conceded under questioning before the Senate Permanent Investigations Subcommittee that he and Navy Secretary Fred Korth, in a memorandum to Defense Secretary Robert S. McNamara, prior to what Zuckert called a "tentative conclusion" to award the contract to General Dynamics last Nov. 13, Zuckert said he did not receive the fourth evaluation report until late the next day.

Zuckert was informed by McNamara on Nov. 13 "that it looks as if General Dynamics would be chosen," Zuckert said. McNamara informed him that the President made no comment on the choice. This was 11 days before a public announcement was made of the selection, and 15 months after McNamara told the President that he would discuss his recommendations with him before reaching the decision.

TFX hearings were suspended indefinitely after Zuckert's testimony to prevent the committee from questioning underworld informer Joseph Valachi. When they resume, Deputy Defense Secretary Russell L. Galpinar is scheduled in the next witness slot.

In his final day at the hearings on Aug. 21, Zuckert discussed the chronology of events leading to the public announcement of the decision. This brought to light for the first time President Kennedy's role in the controversial F-111 decision. He said he had discussions on the contract—expected to be the largest single award in U.S. history—with a value of \$6 billion or more—seen the Defense Dept.'s (AWP) Apr. 1, p. 281 and that he "did not suggest" who should get it.

Zuckert's testimony included a confidential memorandum to him and Korth from McNamara, dated Jan. 18, 1962, concerning a single systems reading. "I have told the President that we propose to discuss with him our recommendations regarding the final award of the TFX contract before the committee," he said.

Some committee members take the view "impermissibility" is the accurate term to mean that McNamara intended to leave the final decision up to the President, rather than risking this decision before.

Key points in Zuckert's chronology, which he supplied to the committee, included:

- Nov. 10, 1962—Zuckert and Korth met from 8:05 to 8:45 a.m. to discuss the major issue, "outlining the pros and cons for each of the two congressional

877. Totals out of a possible 900 were General Dynamics, 682 4 and Boeing, 634 3.

After the Zuckert-Korth meeting the morning of Nov. 13, the two men with McNamara later the same day tried to give her "a bird's eye view of what the score was."

• Nov. 13—Zuckert met with McNamara at 8:35 p.m., immediately after McNamara returned from his White House visit. "McNamara listened to us, and Golloppe had been to see the President. I told him [it] looked like a single TFX for Navy and Air Force could be built." The third member of the team, McNamara and President, told Boeing to "spare no expense but that it amounted to an General Dynamics offered best chance of getting program done and cost, and it looked as if General Dynamics would be chosen." The President made no comment.

Zuckert said later that he is sure McNamara did not tell the President Boeing had operational superiority, but he was unable to explain how this got into his chronology, which he revised four times last March from notes he had made in November.

• Nov. 14—Zuckert and Korth began working on the memorandum to be copied to the Senate. McNamara on first occasion, according to a memo from Zuckert in the defense secretary. The Zuckert memo included a letter from the source evaluation board and another from Gen. Walter C. Swanson, commander of Testbed Air Command. Details of the board letter were not in the recorded transcript. But Gen. Swanson used in his letter, "I believe that Boeing has a much better aircraft" it will provide a superior weapons system that will provide a substantial improvement in TFX capabilities." I believe part of that, that General Dynamics' proposal will not provide the same increased capability," I urge that Boeing be considered in the source."

Zuckert commented that Swanson's views, also shared by the basic Air Force mission, "do didn't give any weight to the combat capability of the General Dynamics plane, so he didn't give any weight to the logic about survivability, and angle of attack, problems, wave, feasible wing sweep, the center field capabilities, the strength of the aircraft."

Zuckert commented that Swanson's views, also shared by the basic Air Force mission, "do didn't give any weight to the combat capability of the General Dynamics plane, so he didn't give any weight to the logic about survivability, and angle of attack, problems, wave, feasible wing sweep, the center field capabilities, the strength of the aircraft."

Aided if he could trust Swanson's judgment in the future because of his apparent "impermissibility" and "easiness," Zuckert expressed "highest respect for his competence." He added, "But one thing I have found in dealing with an congressman, whether it is a senator or member, is that there

Javits Opposes Hearing

Washington—Jacob Javits (R-N.Y.), a member of the investigating subcommittee probing the F-111 (TFX) selection, is pressing his case to the hilt because he feels "the sole question remaining is the wisdom of the judgment of the Defense Dept. in picking General Dynamics over Boeing as the supplier." He said that question does not involve conduct of business, vendor selection, "good sense of discretion," and therefore "is not a proper question for our inquiry."

He made that play on Aug. 21. The day before, he made the same play in the hearings on the grounds that it was being made by Sen. Frank M. Thompson, chairman of the Senate Armed Services Committee. Thompson had told Zuckert he had been in touch with the agency and had received a "no" answer to his request for information on the T-381 evaluation. Zuckert also disagreed with Thompson's assessment of the difficulty of calculating flight test errors.

Zuckert said he relied on his technical knowledge as two aeronautical engineers—Dr. Joseph V. Clark, his very senior scientist of the Air Force and now president of the Communications Satellite Corp., and Dr. Alexander Pines, director of Air Force scientific research and development. "Zuckert's opposition to similar actions as the research and development programs stress how hard, cost and risk factors, all of which he consider excessive," Zuckert said. "The main point of emphasis for the F-111 was based on Boeing's failure to produce substantiating data on the metal's load-bearing characteristics in the way that would be needed for the wing carry through, according to the testimony."

Zuckert also deplored Boeing's top secret, and commented that the Boeing threat letter for F-111 was a "back-of-the-envelope" design. "When I left," Chairman Frank M. McClellan (D-Calif.) said that he had questioned the amounts of "some pretty compete people." Zuckert replied that "some of these figures in a short letter may be misleading."

The subcommittee is attempting to show that the decision on the F-111 was a poor one, and that it was made influenced by the personal involvement of top Pentagon civilians. Korth, whose home is Ft. Worth, Tex., where the aircraft will be manufactured, has been quizzical about how much to General Dynamics by a hand-to-hand combat and Golloppe has been equally loquacious, said the General Dynamics' spokesman.

Zuckert was informed of conflict of interest, and despite some question as to committee members, he refused to be drawn into the place of the investigation. He said that as far his discussions with Korth and Golloppe, "their objectivity was beyond question."

The Air Force secretary was questioned fundamentally on his technical reasons for rejecting the evaluation and recommendations of his military chiefs that the Boeing proposal be accepted and instead going along with McNamara on the General Dynamics proposal.

In his testimony, Zuckert stood back at what he considered the inaccuracy and inconsistency both of Boeing's proposal and of expert witnesses who testified previously, particularly on the use of titanium in the Boeing aircraft. The committee would have to operate over the entire speed-altitude range, it would have to be fully supersonic, and it would be used in conjunction with the missile.

He said that Boeing's price for the revision is unrealistic because it is 93% lower than Pratt & Whitney's, 75% lower than Rohr's and 50% lower than that proposed by General Electric's Titanair. Zuckert's position was that it was Boeing's lack of substantiating data on the use of titanium, not the metal itself, that was rated deficient in the T-381 evaluation. He said Boeing proposed to use titanium at 75% of its structural weight, mostly in the tail, the way through and point support structures.

He conceded that Defense Dept. had suggested the use of titanium as a weight-saving material, but said Boeing justified as almost costlier look-alike substitution for its use.

Testimony brought out earlier that Boeing proposed to use 2,925 lb. of titanium in the Air Force version and 2,315 lb. in the Navy version. The metal specified by Boeing was actually an aluminum-magnesium-aluminum alloy known as 6043D. Zuckert and Boeing used a 16,000 psi yield strength for unnotched titanium in its proposal, and also claimed it is 100% fit to compare to the specifications on the USAF aircraft handbook.

In an extensive cross examination, Zuckert and the handbook in an ergo writing document, "that tells you what the half part is, but not the data that must be substantiated."

In discussing after aircraft using titanium, Zuckert said that about 70% of the structural weight at the North American A-37 is titanium, but the aircraft was designed specifically for the wing loading though titanium is longer used in the North American A-37 or the Grumman A-4F. The Lockheed Hemingway noted pure titanium on wing

Conflict of Interest

Washington—President Kennedy ordered his cabinet to submit changes against New Secretary Fred Korth at his news conference Aug. 28, and he told top Pentagon officials "have examined a very good position" from the Senate majority on the F-111 (TFX).

Rep. K. W. Stassen (R-Minn.) last week asked Attorney General Robert Kennedy to make available evidence of any financial gain to the part of Korth, who has holdings in a bank which funded money to General Dynamics, owner of the F-111. Stassen said that during 1962, while the F-111 competition was being held, Korth had 18 meetings and five telephone calls from General Dynamics officials. He had two visits from Boeing officials in the same period. Rep. Stassen said

spac. This research vehicle is designed for 200 hr. of operation, composed with 4,000 hr. specified for the F-111. *** Air raids.** The subcommittee cited a number of U.S. and foreign aircraft, including the Soviet Blinder bomber, with overhead air raids, as proposed by Boeing, but Dr. Flax said it is assumed that Dr. Zuckert had in mind a nuclear war. F-111 would be composed with the F-111. He said the Blinder is the only one designed to fly above supersonic speeds, and it is the difference between subsonic and supersonic speeds that adds to the risk of including that design in F-111.

Zuckert commented that the Boeing air raid is "one of the significant difficult problems that I think of in being delivered in the Boeing case from the General Dynamics case."

"Here a Boeing, they haven't made a fighter airplane since the F-26 in 1939. They have never made a supersonic fighter airplane, and that takes on the bottom line for themselves."

Although Zuckert argued the conclusion of a number of previous committees, he stands behind at the test-meets of Dr. George Gerard, director of engineering studies at Alfred Reinisch Associates. Gerard said that if Gerard was the correct choice of man, it would be about 33% lighter than that and it might be better for fatigue problems. He confided by saying, "It has the distinct advantage of making the aircraft more maneuverable." In fact, I would question the use of any other material in the system."

Commenting on Gerard's conclusion, Zuckert said the test-meets "is highly superficial justification of the use of titanium. I think that the Boeing presentation has before this committee a much more logical rationale."

Zuckert called the test-meets "a highly superficial justification of the use of titanium. I think that the Boeing presentation has before this committee a much more logical rationale."

He added, "I am from the Air Force," that he and self constitute to be the two top-ranked reporters. We have taken the lead in the Air Force. We have pioneered the research, the proof is that since production began a few years ago we have been far and away that nation's largest user of titanium."

Several committee members had an involved discussion with Zuckert on the paper designation of the F-111. Zuckert said he prefers to call it a "miscalculation, that the principal assumption will be as a fighter aircraft. We will do better with the aircraft to get the best results, but obviously knowing that it is a 'fighter-bomber'—the F-115."

Sen. Karl E. Mundt (R-S.D.) asked Zuckert if he heard that Grumman "was pulled out of the contract entirely."

It does not get approval to assemble the Navy F-111 under at the Long Island, N.Y. plant. Zuckert said he had not heard the name.

Committee's principal subcontractor to Convair Dynamics Under the terms of its contract to provide engineering support for the Navy version, manufactures a number of components and assemblies. However, added Dr. Sen. Carl Levin, "we have congressional review of the final configuration, it is not dependent on the final outcome of the committee. But it doesn't make Defense Dept. Zuckert replied, "No sir, I have no place to go when I get out of here."

productivity for the development jointly in our study, on my desk."

In the matrix of conflict of interest, Zuckert responded to questioning by Sen. Carl T. Corcoran (R-N.H.) to the effect that he has no knowledge other than news reports of the involvement of Kraft and Gillette in defense-associate activities. Added by Sen. Carl Levin, "we have congressional review of the final configuration, it is not dependent on the final outcome of the committee. But it doesn't make Defense Dept. Zuckert replied, "No sir, I have no place to go when I get out of here."

DDR&E Will Monitor Briefings

Washington—Defense Dept. offices which want to pass classified briefings to industry on defense research and development needs will have to notify the director of defense research and engineering at least 90 days in advance and limit the briefings to items having a common technical aspect.

The reason for the long expected directive, July 15, p. 25, which became effective Aug. 14, is to prevent industry from being led into "blind alleys" by military service proposals with per side, according to Walter Carlson, director of technical information at DDR&E. He said such briefings could affect an industry's spending rates and effort on proposals which DOD would not approve.

Industry for controlling control of the briefings came from Gen. Lee C. Lyles, deputy secretary of defense, who last fall sharply ordered Air Force to postpone and revise the contents of an industry-wide briefings. Industry and military services to Defense's move was so strong that subsequent papers meant to analyze briefing procedures used less drastic language than the original Carlson memorandum.

DDR&E will publish a monthly list of meetings and briefings where attendees is limited by the participating organizations and where classified material is to be presented.

There are some of the points of the directive:

- Any national or international in an approved defense program must have advance approval of DDR&E.
- An outline of the briefing must be provided among cognizant defense offices and those involved in the mission to be discussed 90 days before the presentation date. Thirty days before the briefing a complete draft, including stand side and other material not relating to current defense programs, must be sent to DDR&E.
- Briefings should be limited to four hours maximum. Not more than 10% of the program along broad lines which can have a range of influence. The Navy preferred in this policy by requiring an unclassified, weapon and aircraft briefings.
- It is requested that briefings be scheduled as an adjunct to meetings of technical societies or trade associations whenever possible.

DDR&E will publish a monthly list of meetings and briefings where attendees is limited by the participating organizations and where classified material is to be presented.

Youngstown Firm Buys 15 Jet Commanders

Order for 35 Airtac Commanders Model 1121 jet commandos has been placed by Youngstown Aviators of Youngstown, Ohio, which operates aircraft for 39 midwestern corporations on a lease basis.

Total cost of the order will be approximately \$59,450,000 for the 15 aircraft, which will be delivered over a two year period beginning in late 1964. This is the second order by Youngstown and its chairman, Brooks A. Johnson.

Purchase of the first 15 aircraft overall was made to meet increasing long-haul competition by jet-powered aircraft, which has raised a serious decline in the less expensive long-haul business over the past three years.

Titan 2 Makes Successful Flight

Washington—USAF-Mars Titan 2 was launched from Cape Canaveral Fla., Aug. 21 at 5,000 mi. right on schedule. The first German-made rocket of transonic plasma apparently was tested successfully.

Titan 2 also earned a scientific instrument payload prepared by the Air Force Cambridge Research Laboratory. No stratospheric radiation in the Titan's exhaust plumes. The Air Force and predecessor data indicated that the test flight and scientific statements also said, "There have been a large number of Titan flights in which this problem was not evident and which demonstrated an adequate performance margin for the German mission without any modifications in the present system."

NASA officials said the increased pressurization had reduced the oscillation level and that other modifications were still being evaluated.

On Aug. 17, Christopher C. Kraft, director of the Manned Spacecraft Center, and longitudinal oscillations in the first stage of Titan 2 (AW, Aug. 4, p. 27) and low thrust in the rocket's second stage nose cone caused of considerable concern.

Kraft had an interview at a Black-bell, Va., space conference that he cited pressurization in the heatings had reduced the oscillations, which before the modification had for a peak about 115 sec after liftoff and lasted for about 30 sec. He said there may some question whether the increased pressurization had provided a reliable solution.

Kraft said second stage thrust was about 10% below nominal and

Gen. Louis Naudet, former Supreme Allied Commander Europe, has been elected to the board of trustees of Rand Corp., Santa Monica, Calif.

Selection of three personnel will be turned in the use of portable radio equipment to be provided by the U.S. government for a post as training exercise this fall by the Indian, British and U.S. air forces. The portable radio gear will be used for additional training during the exercise and replaced later by permanent installations.

Lockheed-California Co. has test off an additional 100 engines, mostly engines, was having a gradual reduction in the engine's life expectance. Engine parts privately have been affected by the layoffs, with the latest investment bringing the total number of engines delivered since Jan. 1 to more than 930.

General Electric's Missile and Space Div., Valley Forge, Pa., has received \$50,000 contract from the Air Force Rocket Propulsion Laboratory to investigate rocket fuel storage in space. Study will include various solid and solar insulation tests.

U.S. and Soviet Union last week announced final approval of an agreement covering cooperation in warfar satellite programs, passive reflector satellite (Ech-2) experiments and joint contests between the 1965 World Magnetic Survey (AW, June 23, 1962, p. 17).

Lend Electronics Corp. has appointed Edmund M. Siegel as president and chairman of the board. Siegel, a consulting engineer, has management of operations that Siegel attempted to broker a similar company of Aerostar Electronics Inc., according to Lynn Albert, Lend president. Siegel was arrested by FBI agents in Detroit Aug. 17 and accused of attempting to bribe Charles Lopez, chief of ASD's electronic warfare branch concerning a \$5-million negotiated revised contract that Siegel denied that any money was offered or exchanged hands.

NASA Test Pilot Joseph A. Walker flew a North American X-15 research aircraft to a record altitude of 354,000 ft. on Aug. 19 (AW, July 29, p. 24). Details on another transonic-altitude effort is pending collection of flight test data at NASA's Flight Research Center.

North American and NASA made formal the price of the Apollo command and service module—\$375,000 each—for the period through May, 1967. It costs \$11 million, the atmospheric and 10-moonday modules.

Northeast Decision Sets No Precedents

Removal of carrier from Florida market to force drastic changes in eastern U.S. airline competition.

By L. L. Doty

Washington—Civil Aeronautics Board decision to remove Northeast Airlines from the Florida market (AW Aug 19, p. 32) produces a drastic adjustment in the competitive posture of franchises serving the eastern U.S. list to set very standards for the revision of route competition in future cases.

As of late last week, there was no evidence that Northeast has even the slightest chance of recovering any portion of its lost New England-Florida routes. Congressional interest in the case has been curtailed by the chief focus of concern appeared to be on New England regional services.

In any event, proper functioning of the regulatory system prevents Congress from exerting any pressure on the Board. Northeast will file a petition for reconsideration, but since the basis of the majority decision was based on Northeast's inability to attain financial strength from the route, the decision is likely to be unchanged.

In trying to resolve Senate aviation subcommittee last week, James W. Astor, Northeast's president, said emphatically that he did not expect the CAB to provide sufficient subsidy to pay off existing debts—but he says there is no escape from bankruptcy for the airline. The Board and its decision that it would grant Northeast subsidies to provide service to New England.

Majority Decision

The Board's majority decision is far-reaching in its implications and reflects the changes in the competitive environment of the airline industry brought about by the introduction of jet aircraft and the changing nature of jet transportation markets. But as taking cognizance of these factors, the Board often so does as to hope they will be applied in future cases. The majority underscores that point by stating that the industry has a right to expect guidelines as to the degree of competition which the Board will consider in the future.

These elements, coupled with the problems inherent in a temporary air lifeline, deserve more than the passing attention given them in the majority decision. Some more detailed consideration of the reasons behind the decision of Northeast:

- Majority decision noted that two Douglas DC-8 transports could handle two and one-half tons at cruise passenger between New York and Miami as can three Douglas DC-7 piston engine aircraft as the same route with the same number of round trips. The point is allowed to rest with this statement:

we may and offered the carrier no outlet markets during that unusual period.

■ Changing pattern of markets is touched upon in the majority decision but without pursuing the issue to much any policy conclusion. The decision notes that when temporary certification was granted Northeast in 1958, the New York-Miami market generated 33% more passenger miles than the Los Angeles-New York market. It added that in 1962, New York-Los Angeles was generating 19% more passenger miles than the New York-Florida market.

There is strong evidence that other west coast markets are undergoing similar changes. It was not until 1962, for example, that the Board formally recognized the need for a southern transcontinental route to some long-haul markets in the so-called NASA Corridor (AW May 15, p. 11).

Policy Elements

Two important policy elements are implicitly called for in this case. It is no longer realistic to use traffic forecasts as a basis for route decisions unless some account is taken of changing patterns of markets will dictate such forecasts. And the competitive character of the industry should not be permanently redefined because of a change in travel markets. It is highly probable that the Florida market will continue to find traffic growth, which the majority found had not matched forecasts could be restored.

- In his testimony before the Senate subcommittee, Astor characterized a temporary certificate as a "license to go bankrupt." He explained that "many plant expansions, major expenditures of every conceivable type could be, if available at all—or are acquired on more normal terms and conditions when your certificate is only temporary."

Although Alton E. Boyd, CAB chairman, admitted during the Senate hearings that the temporary certificate should be discontinued in avoiding ramp rates, the majority decision takes no stand on this point.

Astor continued during the Senate hearings that he did not know what could be done about retaining Northeast in its former position, but he hoped the hearing would focus attention on the airline's profit so that no one could be treated "as though as Northeast has been."

Astor stressed not only the Board's decision—which he called "ineffective"—but bitterly resented tactfully said by both Eastern and National airlines to

drive Northeast out of business. Malakai A. Makayura, president of Eastern Air Lines, emphatically denied during the hearing that there had been any conspiracy to drive Northeast out of business. His and Northeast had filed a complaint against Eastern before the Board in 1961 on this subject and the Board staff had concluded and issued an order to proceed.

Makayura said that his jet fleet was being increased to sufficient time to handle the flow of traffic during the forthcoming Florida winter season.

Seaboard Cargo Pact Approved By CAB

Washington—Civil Aeronautics Board last week approved of experiments for the use of blocked space by Seaboard World Airlines to three foreign flag carriers but—in the case under—disapproved a similar agreement between Pan American World Airways and Japan Air Lines.

The Seaboard agreement provides for the use of cargo space on certain transatlantic flights operated by Seaboard to British Overseas Airways Corp., Lufthansa and Swissair (AW July 15, p. 33). The Pan American agreement involved the use of cargo space on Pan American's London-Moscow CL-44 intercontinental transports.

The Pan American agreement with Japan Air Lines provides for the operation of three weekly round trip flights between San Francisco and Tokyo, with a Boeing 707-321C aircraft per flight. It is to be used by the Japanese flag carrier at a space rate of 20 cents per mile.

The CAB found that the blocked space arrangement has helped Seaboard

improve its cargo revenue.

In denying the Pan American agreement, the Board said Pan American and JAL are the flag carriers with freedom to exercise rights in the Caribbean-Taiwan cargo market.

Seaboard Complaint

Washington—Seaboard World Airlines last week filed with the CAB a complaint against Pan American World Airways and United Air Lines, contending that the two carriers had violated the Federal Aviation Act, Sherman Anti-trust Act and the Civil Aeronautics Act through a joint working agreement on the sales and marketing of cargo operations.

Seaboard said it understood that the agreement had not been filed with the CAB as required by the Federal Aviation Act. Specifically, Seaboard charged that the agreement fails to provide for equal working arrangements, pooling of cargo rates and senior resources, firm sales agreements, division of markets exclusive dealing arrangements, agreements not to compete

with each other and other unfair practices.

■ Thanks noting of the U.S. flag carriers should be changed to provide a direct competition with British Overseas Airways Corp. from western Europe to the West Coast, and with BOAC and Quantas on or around the same route.

■ Thanks the U.S. flag share of the

BAC 111 Makes Maiden Flight

Born, England—British Aircraft Corp.'s first BAC 111 transport aircraft made a successful maiden flight Aug. 29 after a delay caused by thunderstorms and a blade problem.

The aircraft, ZK800, United Airways markings (AW Aug. 29, p. 42), took off due to bad weather at 11:45 A.M. with Capt. C. G. R. (Bill) Green at the controls. Green said he returned to land at 1:00 P.M. and was 1,300 ft above the ground.

Took the BAC 111 to 4,000 ft for a series of maneuvers in the landing configuration. Top speed reached was 190 M.P.H. and Green reported no vibration shortly at 30,000 ft. Landing at Watford, which had ordered 20 of the 49 aircraft now sold, will get a six-service and customer facility on the London-Geneva route starting in F.A. 1968, BAC managing director.

First flight disclosed a 27-month development program started by British Aircraft's entry in May, 1963 (AW May 15, 1963, p. 42). First overseas customer will British International. Festage for the first British airplane is new seating equipment at BAC.

Transatlantic Case Delay Creates Dilemma on Foreign Competition

Washington—Civil Aeronautics Board's preoccupation in preparing the long-drawn Transatlantic Route Revision Case has forced the Board to spend its time on how best to use foreign airline competition.

For years ago, the Board was first inclined to ignore the problem. Instead it granted temporary certificates to various foreign carriers.

Opposing carriers—mostly European—then sought to eliminate the foreign carriers by signing some type of equity control agreement. Most oil the blues for the poor financial showing of U.S. flag carriers were nothing that was attributed to the growing number of foreign foreign carriers.

The Board continues to set the equity control (AW Aug. 12, p. 35) despite a substantial number of air traffic, but places a heavy burden on the airlines of the cost of Pan American and TWA in order to reduce competition and capacity between the two U.S. flag—thereby to enable them to compete against foreign airline effectively.

Fair winds of legislation in the recent case or fair have indicated that the Board.

■ Still with capacity control over for air traffic, even though the entire practice situation is not as acute as in the past.

■ Thanks noting of the U.S. flag carriers should be changed to provide a direct competition with British Overseas Airways Corp. from western Europe to the West Coast, and with BOAC and Quantas on or around the same route.

■ Many of the two airlines would be a more practical solution. Pan American continues, since its planned marketing expansion in Europe would receive strong support from TWA's domestic market.

The hearings are expected to run at least two more weeks before a final determination before Examiner James Keith

Dulles Faces Struggle to Prove Design

By Robert H. Cook

Washington—Dulles International Airport, the controversial "better mouse trap" of airport design, faces an uphill battle of several years before its superiority can be proved conclusively either to the airline industry or the public.

A startling contrast to the finger concept adopted by virtually all other major hub airports, Dulles already is emerging as one of the most conventional terminals ever designed for the passenger.

Consort design of the 660-ft. long terminal building allows the passenger to select his ticket counter and mobile lounge departure gate with a minimum sweep of the eye, in contrast to the sprawling confusion of airports such as O'Hare.

Complaints about the distance that passengers must walk—a major source of concern at most airports—are virtually non-existent at Dulles because of the design of the building and proximity of mobile lounge departure gates to passenger facilities and ticket counters.

Mobile Lounge Concept

In short, the designers of Dulles have eliminated the physical handicap of extensive walking distances and the psychological expansion of sheer anxiety by substituting the mobile lounge concept for connecting finger systems between the terminal and aircraft operations.

Even the problem of ground travel time between the airport and downtown Washington has been considered by the Dulles planners. Located about 22 miles from the nation's capital, the new port is served by 14-ft. 6-in. of limited access dual highway, connecting with an express road route into the city.

The limited access portion was built as a part of the airport project and is reserved exclusively for airport access and visitors. Ground travel time for the passenger is now about 30 min from the middle of the city but planned construction of a new connecting highway by the state of Virginia within the next four years should reduce this time to only 18 min.

However, the passenger traffic volume at Dulles is so light that it probably will require three more years before any accurate assessment of its capability can be accomplished. Scheduled airline operations now total about 74 flights a day, or less than half that of nearby Friendship International Airport at Baltimore and less than one-tenth of the volume at Newark in New York.

Just as it took time for a significant shift of traffic from Willow Run to

Wayne Mayor Airport in Detroit and from Midway to O'Hare in Chicago, it will take time for a similar transfer from Friendship and Washington National to Dulles.

Airlines are continuing to shift major airline schedules from Friendship to Dulles and a continued bias on jet traffic at Washington National can be expected to contribute to Dulles' growth if more current introduction new airline-stage jets such as the Boeing 727, the Douglas DC-9 and the British Aircraft Corp. BAC 111.

Most of this shift will occur during the next two years and the Federal Aviation Agency predicts that by 1965, Dulles will be handling 2 million passengers a year. Traffic growth this year should reach FAA's forecast of 2 million passengers.

By 1970, traffic volume is expected to reach 6 million passengers, requiring an extension of 600 ft. to the terminal building. The building now has provisions for 24 mobile lounge with a capacity for 36 positions by 1973 and an ultimate capacity of normal rating gate positions from the present 100 to 90.

As an indication that Dulles will reach these traffic goals with little difficulty, FAA has to compare traffic growth in the last six months with that of O'Hare and Idlewild in 1953.

Pakistan Training

New York—Flight training for Pakistan International Airlines crews flying the carrier's new Lockheed Constellation in East Pakistan will be conducted with a Hawker 800, currently purchased by the airline and shipped by air to Pakistan.

Robert Brough, Hawker's export sales manager, is spending two months in Pakistan clearing out problems on the four-seat Et. Certified aircraft will fly the 25-passenger Standard 811N in regular service (IAW June 8, 1962, p. 44).

The airline also plans to use the Hawker as a charter, executive and tourist aircraft. The airline also is anticipated for periods of maximum floods

O'Hare began operations with 652 aircraft and 1,000 passengers per day. The figure reached 734 after one month. Idlewild reached 735 passengers in a month after opening on Aug. 14, 1948. Dulles began operations in November with a total of 793 passengers and reached a total of 5,272 passengers per month by the end of the March.

In the running argument with Idlewild over the switch of airline traffic from Friendship to Dulles, some FAA experts contend that Dulles has been fighting to retain traffic which it has already been entitled to have.

Under FAA regulations, any airport desiring to qualify as a major airport is required to handle at least 10% of the total U.S. traffic. In 1953, Friendship handled 6.43% and reached 0.95% in 1961, only when the writers were forced to build yet again there because of the bias in effect at Washington National.

Washington National

In comparison, Washington National has been handling more than 4% of the U.S. traffic since 1959. On the basis of these figures, these FAA experts contend, Friendship's claim to be a major airport is open to question.

Tony Dulles is a good compromise study to handle new traffic growth as it is added. All operational facilities, including those unenclosed canopies, the tower and support equipment are completed. It still lacks a mobile lounge, which will be built by the airlines, but at completing a new air cargo building at a cost of \$600,000. Rainiers, two of which are 11,500 ft. and a third 10,000 ft. long, are planned to 900,000-lb. gross landing weight, enough to accommodate the proposed superjumbo transports.

Construction of a 54,000-ft. hangar located on airport property has begun. It is scheduled for completion next year. Public parking facilities will be expanded at a cost of \$2.2 million next year to provide 1,700 parking spaces and plans for the building of two private office buildings in the terminal area are being discussed.

FAA anticipates spending an additional \$21 million over the next five years for further expansion of Dulles. This plan calls for at least 14 more large planes.

The mobile lounge, as the sole link between the aircraft and the terminal building, should hold the key to Dulles' success or failure in the future.

For an aircraft-on-wheels, the mobile lounge holds the dubious distinc-

tion of being the most primitive and maligned piece of equipment to enter the airline industry. Dulles now has 21 lounge. They were purchased at an average cost of \$282,000 each—a point most often singled out by objection to the lounge concept. FAA contends that it had chosen to save on costs and save money, so the decision to buy mobile lounge units was made.

This addition of special mobile equipment for general control would mean a total investment of nearly \$100,000 to service one aircraft.

Just as an initial airport "debugging," so has the mobile lounge—but its problems have all been minor ones, FAA claims. Most involved modifications to the power supply and break system, overhauling of air conditioning units during hot weather and premature leakage of transmission clutch pads. Majority of the malfunctions were corrected in the prototype lounge made manufacturing warranties granted by the Chrysler Corp.

One unfortunate note on the lounge is that it is slow. The cost for each gate house figure about 2,200 sq. ft. and the prototype 1,800 sq. ft.

The lounge are under a propane maintenance schedule similar to an aircraft maintenance procedure, with a daily 1½-hr. check plus intermediate checks at 25- and 100-hr. intervals. Several lounge houses already passed their 100-hr. checks as a schedule which extends to 1,000 hr. Each check cycle, a confined in the mobile lounge bags, which holds 10 lounge units. Chrysler inquire about that hours and FAA controls that maintenance costs are "the lowest" what they expect.

The lounge cost about \$10,000 each, a high price for each of the two engines and they are around as the limit of losses used either than storage.

Eventually FAAs hope the unit purchase cost of each lounge will be less than the current price, which includes amortization of about \$1 million in research and development costs. As additional lounges are ordered, price will be negotiated with Chrysler.

There also is a hope that other foreign airports may adopt the mobile lounge concept and that further lower the cost of ownership. FAAs feels that the cost of the lounge, at necessary operational capacities, could be reduced either to full or in part under the Federal Act to Airports Act.

Initial operation of the mobile lounge first brought a fury of opposition from all segments of aviation in the U.S., Puerto Rico and the Virgin Islands. Last year, FAAs felt that the cost of the lounge, at necessary operational capacities, could be reduced either to full or in part under the Federal Act to Airports Act.

Initial operation of the mobile lounge

on the lounge is now around 4 mi to the airport, with an average of 6 mi for departs passengers.

FAA has increased this has been a continuing need to modify the lounge arrival and depart times to the needs of the individual airlines. A standard 15 min is now added to both the arrival and departure times to be arrested for mobile lounge loading, unloading and travel time. These times are published in airline timetables and displayed on information boards.

Airlines during different times rarely use the terminal facilities. American and Eastern, for example, add only 10 min to their schedules for the mobile lounge time.

The lounge operators has also suffered some criticism from the public

because of airlines' use of mandatory stop steps with the curb. Most carriers place these stops in position for use by ground and flight crews after the mobile lounge has landed and departed for the terminal.

But Eastern Air Lines has been placing the stops in position first and during the arrival stage. It was a long-standing before the mobile lounge was installed.

Effect of the procedure on the missing passengers, who are important to checkin through a long journey, has been to create the suspicion that the lounge operators does not function properly.

(This is the eighth and final article in AVIATION WEEK & SPACE TECHNOLOGY series on major U.S. airports.)

Airport Aid Stresses Small Fields

Washington—Federal Aviation Agency has allocated \$15.7 million for the construction and improvement of 45 small and medium airports under fiscal 1964 budget that emphasizes development of small general aviation airports.

Patuxent of the allocation closely documents that most major hub terminal expansion has been completed. As opposed to the chronically heavy concentrations of the past year, but less emphasized of the fiscal 1964 allocation was set aside for 26 terminals in the major hub airports.

Completion of most of the expansion of large terminals has enabled FAA and the state governments to give a lagging priority to the smaller airports. The budget for more than 150 of these small and medium airports is included in the airport projects programmed for the year involving acquisition of land for expand airports in the non-hub and general aviation plates or building new ones.

Eventually FAAs hope the unit purchase cost of each lounge will be less than the current price, which includes amortization of about \$1 million in research and development costs. As additional lounges are ordered, price will be negotiated with Chrysler.

The remaining \$57.2 million has been allocated to 199 airports serving all segments of aviation in the U.S., Puerto Rico and the Virgin Islands. FAAs feels that the cost of the lounge, at necessary operational capacities, could be reduced either to full or in part under the Federal Act to Airports Act.

Initial operation of the mobile lounge first brought a fury of opposition from all segments of aviation in the U.S., Puerto Rico and the Virgin Islands. Last year, FAAs felt that the cost of the lounge, at necessary operational capacities, could be reduced either to full or in part under the Federal Act to Airports Act.

Initial operation of the mobile lounge

of these projects is the \$5.3 million authorized for runway and taxiway extensions at L-Gaithersburg Airport. Also included in the total is \$1.8 million for the Coastal Bellair International Airport and \$1.8 million for the Rock Creek Marine Coast Guard Airport.

Coldren has the highest number of projects—35—and the second largest allocation at \$16.6 million at \$6.3 million San Francisco, Sacramento and Santa Ana have the largest proposed expansion programs with \$1 million authorized for a minor build and expansion at San Francisco International Airport, \$1 million for a new 8,600-ft. runway and \$1 million projects at the Sacramento County Regional Airport and \$1.2 million for general improvements to the Orange County Airport and Santa Ana.

Florida is third in the allocation rank, with 28 proposed projects totaling \$5.6 million in federal aid. The two largest areas involved are \$2.2 million for airport land acquisition by the new Jacksonville Municipal Airport and \$2.1 million for land purchase and construction of two 4,000-ft. long landing strips at the Mid-Florida Coastal Airport in Dade County.

Texas has been allocated \$5.3 million for the program with the largest amounts of \$3.7 million cleared by the Houston airport. Majority of the Houston area will be spent for land acquisition needed for general airport development and approaches to runways.

Georgia, perhaps because of proposed expansion of the Atlanta Municipal Airport, also ranked among the top allocations with \$4 million. Pending final approval by the FAA, Atlanta would claim \$1.5 million of this sum for runway extension and a new 8,000-ft. long runway to parallel its existing runway #3.



- 1 The Spey powered BAC One-Eleven has been ordered by 7 airlines in 5 countries
- 2 The Spey has completed more than 82,000 hours development running including over 4,000 hours in the Hawker Siddeley Trident
- 3 Flight testing of the Spey powered Hawker Siddeley Buccaneer S.2 strike aircraft is now proceeding
- 4 Spey powered Tridents are being delivered to British European Airways this year

The Spey is winning world acceptance

Production engine deliveries of the Spey are building up fast. And more and more airlines are showing firm interest in the engine for their re-equipment programmes.

In its design and rating the Spey is based on Rolls-Royce's unique experience of commercial turbine operation. This is your assurance of the operational economy vital for profit-

able use of the short-haul jet.

The Spey will bring to jet travel all the inherent qualities of the Dart, which powers the Vickers Viscount, the Grumman Gulfstream, the Fairchild F-27 and the Whitworth-Gloster Argosy—all in service in North America.

A NEW PHASE BEGINS WITH ROLLS-ROYCE POWER

ROLLS-ROYCE OF CANADA LIMITED, 2265 COTE DE LIÈGE ROAD, MONTREAL, P.Q.

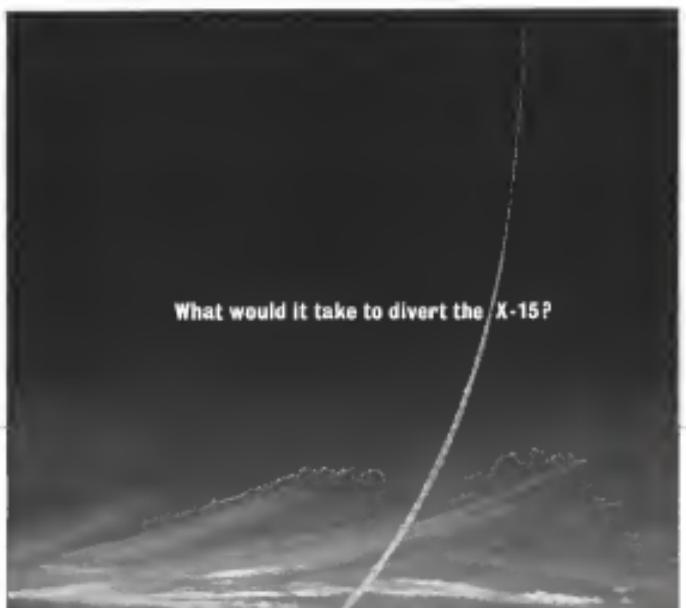
U.S. Scheduled Service Load Factors—Jan.-June, 1963

Region	Base Miles Miles 1,000	Avg. Pass. Pass. 1,000	Total Miles 1,000	Avg. Load Factor (%)	Average	Year Miles 1962		Avg. Load Factor (%)	Gross-R S.F.
						Revenue Revenue	Avg. Tow Load		
DOMESTIC TRUNKS									
Airwest	83,049	8,791,158	2,038,929	61.9	91.6	\$3	0.2181	812,491	4.86
Braniff	12,318	851,712	1,166,623	58.2	79.3	33	0.6476	165,569	4.36
Continental	12,157	849,200	1,041,363	57.8	79.1	33	0.6471	152,561	4.35
Delta	56,189	1,581,848	2,486,010	58.4	81.8	31	0.6770	322,516	4.64
Eastern	20,209	2,332,404	4,041,491	49.9	67.9	90	0.5581	410,802	4.75
National	12,272	825,498	1,411,363	54.2	74.2	23	0.7426	354,419	5.05
Northwest	10,103	741,200	1,041,363	57.8	79.4	33	0.6474	174,256	4.35
Southwest	10,103	762,040	1,554,470	56.6	79.9	38	0.6945	216,758	5.30
Twa World	20,512	2,155,137	4,798,753	50.6	71.5	31	0.6131	448,649	4.87
United	88,418	2,327,325	7,446,220	58.8	75.7	31	0.6749	995,329	5.21
Western	14,461	636,716	1,268,400	52.0	79.2	23	0.6250	125,150	4.81
Dom. Trunk Total	389,782	37,388,767	33,741,236	57.1	79.3	33	0.6691	2,899,131	4.86
DOMESTIC REGIONAL									
Airwest	1,700	3,007,177	1,000,000	57.2	79.2	33	0.6716	224,049	4.71
Braniff	1,420	71,771	156,773	4.3	54.6	45	0.2116	20,343	5.72
Continental	1,656	28,771	100,000	48.2	72.2	28	0.5265	2,285	4.45
Delta	1,249	24,249	42,000	52.7	79.2	33	0.6471	1,016	5.15
Eastern	3,534	492,912	190,473	70.2	85.0	34	0.6186	91,354	7.36
National	212	7,738	26,297	17.4	29.2	33	0.5087	2,371	1.89
Northwest	246	544	100,000	58.4	79.2	33	0.6471	2,210	5.20
Southwest	1,544	10,149	100,000	58.8	79.2	33	0.6471	25,410	5.83
Twa World	1,189	1,011,171	1,000,000	56.6	79.2	33	0.6471	91,371	5.85
United	53,121	1,351,187	1,000,000	56.6	79.2	33	0.6471	104,561	9.87
Western	1,101	49,656	100,000	57.2	79.2	33	0.6471	7,084	12.38
Dom. Regional Total	87,894	5,346,417	10,031,407	57.7	79.2	33	0.6691	1,470,192	5.86
LOCAL SERVICES									
Airwest	1,024	1,024,000	1,000,000	57.2	79.2	33	0.6716	72,514	4.71
Alaska	3,006	87,204	114,238	23.4	56.6	29	0.6707	11,322	2.23
Continental	3,460	34,189	93,278	10.3	37.2	38	0.3881	9,747	1.18
Delta	3,455	65,041	177,507	16.6	51.4	30	0.7049	16,185	2.89
Eastern	1,024	1,024,000	1,000,000	57.2	79.2	33	0.6716	72,514	4.71
Midwest	2,849	102,860	310,710	30.8	42.9	35	0.6203	13,023	2.13
North Central	2,139	63,168	250,203	12.6	33.3	38	0.6206	34,845	1.68
Southwest	1,240	24,249	100,000	57.2	79.2	33	0.6716	72,514	4.71
Southwest	1,240	24,249	100,000	57.2	79.2	33	0.6716	72,514	4.71
Southwest	1,240	24,249	100,000	57.2	79.2	33	0.6716	72,514	4.71
Southwest	1,240	24,249	100,000	57.2	79.2	33	0.6716	72,514	4.71
Southwest	1,240	24,249	100,000	57.2	79.2	33	0.6716	72,514	4.71
Local Services Total	88,916	824,985	1,000,000	57.4	79.2	33	0.6691	114,098	4.81
ALASKA & HAWAII									
Alaska Airlines	932	22,878	7,028	37.2	53.8	23	0.5111	3,958	2.52
Alaska Central	2,720	3,189	7,028	4.4	58.8	44	0.2116	782	4.47
Alaska	1,024	1,024,000	1,000,000	57.2	79.2	33	0.6716	72,514	4.71
Continental	1,265	1,265	3,189	23.3	51.0	29	0.5111	593	2.73
Hawaiian	1,397	33,433	40,479	22.6	49.3	38	0.5111	7,085	2.43
Delta	1,170	1,170	27,000	17.0	41.1	21	0.5087	1,208	2.20
Delta	1,170	1,170	27,000	17.0	41.1	21	0.5087	1,208	2.20
Delta	1,170	1,170	27,000	17.0	41.1	21	0.5087	1,208	2.20
Delta	1,170	1,170	27,000	17.0	41.1	21	0.5087	1,208	2.20
Delta	1,170	1,170	27,000	17.0	41.1	21	0.5087	1,208	2.20
Delta	1,170	1,170	27,000	17.0	41.1	21	0.5087	1,208	2.20
Delta	1,170	1,170	27,000	17.0	41.1	21	0.5087	1,208	2.20
Delta	1,170	1,170	27,000	17.0	41.1	21	0.5087	1,208	2.20
Delta	1,170	1,170	27,000	17.0	41.1	21	0.5087	1,208	2.20
Alaska & Hawaii Total	9,140	184,101	107,307	18.1	47.2	39	0.6194	21,827	4.74
HELICOPTERS									
Los Angeles	303	970	6,584	2.6	12.6	65	0.3779	379	2.65
New York	303	3,044	6,584	11.6	55.9	44	0.3779	737	4.45
Helicopter Total	303	6,118	13,168	2.6	12.6	65	0.3779	1,116	4.45
CARGO & OTHER									
Avalon	161	418	1,149	8.3	11.2	20	0.5111	119	0.91
Phantom Tiger	1,399	1,399	1,000,000	57.2	79.2	33	0.6716	95,318	4.60
Standard	2,420	2,420	1,000,000	57.2	79.2	33	0.6716	104,349	4.60
Sky	933	933	1,000,000	57.2	79.2	33	0.6716	104,349	4.60
Gauge & Other Total	4,428	4,428	1,000,000	57.2	79.2	33	0.6716	104,349	4.60
Initial Total	316,456	31,081,614	43,462,716	49.3	58.7	33	0.6196	8,226,109	4.66
Airlines Best For Available Seats in 1963									
Alaska Airlines	1,170	1,170	1,000,000	57.2	79.2	33	0.6716	72,514	4.71

Printed by R. E. Bell

U. S. Airline Scheduled Service Traffic Growth First Six Months, 1963 over 1962

Region	Percent Increase-Miles 1963	Average Load Factor 1963	Revenue Miles 1963			Revenue Miles 1962	Revenue Per Miles 1963
			Domestic	Int'l.	Int'l. + Domestic		
DOMESTIC TRUNKS							
Americana	-1,204	2,744,198	172,941	34	31	211,379	40.10%
North	205	241,412	20,646	32	33	181,370	2.69%
Continental	100	169,749	14,036	44	43	140,208	19.37%
Delta	101	181,370	14,036	44	43	140,208	19.37%
Southwest	2,320	27,332,073	197,470	74	70	236,417	10.81%
Midwest	214,876	133,724	11,733	41	41	104,149	14.00%
Northwest	100	100,000	10,000	41	41	80,000	12.50%
Southwest	100	100,000	10,000	41	41	80,000	12.50%
West Coast	100	100,000	10,000	41	41	80,000	12.50%
East Coast	100	100,000	10,000	41	41	80,000	12.50%
Midwest	100	100,000	10,000	41	41	80,000	12.50%
Southwest	100	100,000	10,000	41	41	80,000	12.50%
West Coast	100	100,000	10,000	41	41	80,000	12.50%
East Coast	100	100,000	10,000	41	41	80,000	12.50%
Midwest	100	100,000	10,000	41	41	80,000	12.50%
Southwest	100	100,000	10,000	41	41	80,000	12.50%
West Coast	100	100,000	10,000	41	41	80,000	12.50%
East Coast	100	100,000	10,000	41	41	80,000	12.50%
Midwest	100	100,000	10,000	41	41	80,000	12.50%
Southwest	100	100,000	10,000	41	41	80,000	12.50%
West Coast	100	100,000	10,000	41	41	80,000	12.50%
East Coast	100	100,000	10,000	41	41	80,000	12.50%
Midwest	100	100,000	10,000	41	41	80,000	12.50%
Southwest	100	100,000	10,000	41	41	80,000	12.50%
West Coast	100	100,000	10,000	41	41	80,000	12.50%
East Coast	100	100,000	10,000	41	41	80,000	12.50%
Midwest	100	100,000	10,000	41	41	80,000	12.50%
Southwest	100	100,000	10,000	41	41	80,000	12.50%
West Coast	100	100,000	10,000	41	41	80,000	12.50%
East Coast	100	100,000	10,000	41	41	80,000	12.50%
Midwest	100	100,000	10,000	41	41	80,000	12.50%
Southwest	100	100,000	10,000	41	41	80,000	12.50%
West Coast	100	100,000	10,000	41	41	80,000	12.50%
East Coast	100	100,000	10,000	41	41	80,000	12.50%
Midwest	100	100,000	10,000	41	41	80,000	12.50%
Southwest	100	100,000	10,000	41	41	80,000	12.50%
West Coast	100	100,000	10,000	41	41	80,000	12.50%
East Coast	100	100,000	10,000	41	41	80,000	12.50%
Midwest	100	100,000	10,000	41	41	80,000	12.50%
Southwest	100	100,000	10,000	41	41	80,000	12.50%
West Coast	100	100,000	10,000	41	41	80,000	12.50%
East Coast	100	100,000	10,000	41	41	80,000	12.50%
Midwest	100	100,000	10,000	41	41	80,000	12.50%
Southwest	100	100,000	10,000	41	41	80,000	12.50%
West Coast	100	100,000	10,000	41	41	80,000	12.50%
East Coast	100	100,000	10,000	41	41	80,000	12.50%
Midwest	100	100,000	10,000	41	41	80,000	12.50%
Southwest	100						



What would it take to divert the X-15?

But that can't even be seen until the naked eye could throw the X-15 way off the base line of its soaring flight. Let these microscopic particles later in use of the extremely fine tolerance action or valves of the hydraulically operated flight control systems—and things begin to happen! The trouble is, this would be happening at an altitude where you can't see the rightmost particle without a microscope to examine areas as small as 10 microns.

The problem of maintaining hydraulic system purity was solved in the early days of the X-15's development by installing two specially designed Purulator Filters. Of compact design in weight-saving aluminum, these filters remove 100% of all particles 25-microns or larger. The elements are of thermal shock-resistant stainless steel wire cloth—capable of functioning efficiently through a +40° F. temperature range.

Purulator's creative design and development of the X-15's high pressure hydraulic filter is just one of its many contributions to aerospace progress. Purulator Filters have helped solve filtration problems for virtually every type of airborne and ground support equipment produced by the aerospace industry. For more information in terms of your filtration needs, write today. No obligation... and we'll send you a copy of Purulator's new quarterly publication "Aerospace Filtration". It's packed with features and articles of particular interest to engineers active in the aerospace industry.

Write to Purulator Products, Inc., Salt Lake City, N.J.



This is Purulator's Filter #4123. 20 mic. flow capacity, about 310° F. It has a maximum operating temperature of 410° F. It provides 100% efficiency of particles 25-microns or larger and 99.9% efficiency of particles 10 microns. Designed for oil and hydraulic pressures it has a maximum operating pressure of 400 psi and is rated with limited rated values.

Please See Every Dealer
PURULATOR

PROGRESSIVE INC.
NEWARK NEW JERSEY LOS ANGELES CALIFORNIA

Airline Income and Expenses — May 1963

(In Thousands of Dollars)	OPERATING EXPENSES						Total Operating Expenses	Net Profit (or Loss)
	Passenger	Cargo	Other Non-Mail	U.S. & Foreign Mail	Product Deficit	Total		
DOMESTIC AIRLINES								
American	34,229	2,234	37	784	—	37,250	76,712	319
Delta	4,491	410	116	1,125	7,125	8,726	29	
Continental	2,430	583	38	183	6,183	8,768	328	
Rocky	10,173	5,648	333	16,499	14,499	36,310	837	
Stevens	1,043	1,248	199	1,148	2,646	5,087	1,000	(1,000)
National	7,163	655	49	126	8,246	8,502	27	
Northwest	2,120	118	95	96	3,068	4,103	11,148	301
Trans World	2,034	459	22	941	8,867	8,357	301	
United	1,213	1,213	343	4,634	12,792	20,639	1,411	
Braniff	44,123	2,570	156	1,987	44,799	46,608	1,437	
Alaska	4,264	318	110	189	6,791	3,508	305	
Domestic Total	107,706	12,410	1,455	6,760		164,860	169,370	(1,491)
INTERNATIONAL								
Australia	477	89	17	41	254	1,167	204	
Caribbean	403	29	6	127	459	476	231	
India	234	29	—	1	380	337	337	
Europe	3,472	169	1	45	2,826	2,826	2,826	
Mexico	1,079	37	32	176	1,079	1,079	1,079	
Others	1,604	448	238	4,467	3,334	4,467	493	
Passenger	3,191	350	118	1,328	1,727	1,727	1,727	
Freight & Mail	22,323	4,359	3,047	5,795	45,660	45,660	45,660	
Lease & Charter	1,041	1,041	1	18	1,041	1,041	1,041	
Texas Caribbean	50	56	331	1	381	381	381	
Island World	8,124	886	94	1,765	18,660	18,660	18,660	
United	3,143	72	27	105	2,714	2,714	2,714	
Others	394	16	7	5	820	442	442	
International Total	33,783	8,314	8,377	6,341		71,467	68,776	2,691
LOCAL SERVICE								
Atlanta	7,074	100	10	4	934	1,191	1,191	19
Baltimore	709	20	10	4	934	410	410	57
Central	404	34	7	20	269	269	269	26
Florida	2,785	54	20	127	681	1,675	1,675	228
Lake Central	392	26	9	10	584	584	584	16
Midwest	1,413	76	47	206	1,025	2,391	2,391	208
New England	1,041	93	20	127	2,108	2,108	2,108	20
North Central	1,041	93	20	127	2,108	2,108	2,108	20
Northwest	415	26	6	45	458	516	516	52
Pacific	634	26	6	22	205	1,081	1,081	95
Plains	1,215	66	82	246	671	1,927	1,927	198
Seattle	754	45	19	10	528	727	727	17
Texas-Fexas	340	81	8	17	946	1,545	1,545	8
West Coast	975	31	13	10	920	1,027	993	17
Local Service Total	11,940	874	109	345	1,464	16,199	16,194	5
ALASKA & HAWAII								
Alaska Airlines	277	87	196	73	145	741	741	1
Alaska-Central	27	20	1	17	44	44	44	4
Alaska	319	7	6	2	17	421	421	123
Calif.	34	16	26	2	35	710	710	21
Hawaiian	207	84	61	1	10	271	271	172
Hawaiian	20	1	7	6	4	42	42	21
Int'l. Consolidated	314	42	2	94	31	385	385	163
Pacific Northwest	319	160	18	118	38	1,137	1,137	192
Rescue Airlines	142	46	14	81	81	249	249	17
Western Airlines	113	3	3	1	11	247	247	111
West Coast	113	43	178	100	969	1,438	1,438	311
Alaska & Hawaii Total	3,546	935	214	641	429	7,397	7,397	11,991
HELICOPTERS								
Chicago	79	—	—	—	157	157	157	7
San Angeles	71	14	1	12	132	270	270	27
New York	120	6	19	5	170	410	410	35
Helicopter Total	120	22	31	31	123	627	627	46
CARGO & OTHER								
Amtrak	875	—	3,200	—	3,200	6,283	3,738	344
Flying Tiger	756	310	—	—	310	1,272	1,272	1,057
Embraer	937	810	—	618	810	1,126	1,126	28
Rockwell	—	—	—	1,742	1,742	1,742	1,438	7
Miss	—	—	—	—	—	—	—	—
Cargo & Other Total	3,488	6,446	412	6,486	6,486	8,144	8,144	14
Industry Total	346,073	33,419	18,118	19,092	6,837	303,246	267,433	1,228

Reprinted By Ray & Son

DOUGLAS DC-8F GIVES



AIR CARGO ITS BIGGEST LIFT!

A new performance record for the books has been credited to a new DC-8F jet freighter, recently delivered to Trans-International Airlines.

In its first eight days of contract operations by T.I.A. for the Military Air Transport Service, the big Douglas cargo-jet delivered a total of 234,637 pounds of freight to Southeast Asia from California. Distance logged on the three round trips was more than 50,000 miles.

On one of these trips it airlifted the heaviest payload ever carried operationally by any transport—87,028 pounds—from Travis Air Force Base near San Francisco 6,900 miles across the Pacific to Saigon, South Vietnam. Stops were made at Honolulu and Guam.

This record-breaking jet freighter has a ferry range of more than 7,200 miles and a cruising speed above 575 mph.

In addition to T.I.A., other airlines which have DC-8Fs in operation or on order include Capitol Airways, KLM Royal Dutch Air Lines, Trans-Canada Air Lines, Trans Caribbean Airways, and United Air Lines.

DOUGLAS
AIRCRAFT DIVISION

DOUGLAS BUILDS GREAT TRANSPORTS

AIRLINE OBSERVER

SHORTLINES

► U.S. domestic airlines have reported a net profit of \$3,294,000 for the first six months of 1963 (AW Aug 13, p. 47), compared with a net loss of \$7,122,000 in the same 1962 period. Industry total net earnings for June reached \$15.6 million, more than double the net gain of \$7.6 million so far last year. Total first-quarter operating revenues for the 11 lines in current service totalled \$1,781 billion and operating expenses were \$1,735 billion. For the three years in 1962, operating revenues were \$1,726 billion and operating expenses were \$1,732 billion.

► New drive in expand competition on the relatively new southern transcontinental route (AW May 6, p. 42) has been launched. Continental Airlines has made a bid to the Civil Aeronautics Board to extend its present routes into Georgia and Florida, which would give the carrier a route from the West Coast to Miami and Atlanta. American Airlines also seeks a Miami-Orlando route with an eye toward opening overlaps, east-to-west service on the route. Status lists from other carriers may be expected as a result of an invitation by the Board calling for suggestions on the scope of hearings in the case which was remanded to the Board by the Court of Appeals last week.

► Alitalia Co. of America (Alitalia), not wishing to relinquish any ground to the steel industry, has initiated a publicity campaign boasting development of a March 2 passenger transport cabin that is March 1. Alitalia argues that a March 2 aircraft could be built at less per-kilometer cost, could be available sooner and would be more economical for U.S. domestic routes.

► Red China added to its growing fleet with Russia by going wide-bodied to the crash of an Aeroflot Boeing Tu-104 that had to land at Irkutsk Airport last month. Soviet press virtually blamed the accident, which killed the Albanian ambassador to China, an other Albanians and three Chinese. Russians of the Albanian and Chinese victims were brought to Peking in a box public barrel, attended by Premier Chou En-lai and other top Red Chinese officials.

► De Havilland Aircraft Co. is considering the production of a group of Comet 4C transports on speculation. Manufacturing already began production of five Comets without orders and since then sold three—two to Kuwait Airways and one to United Arab Airlines. Negotiations for the other two are under way with Middle East Airlines and Royal Air Force.

► Equity financing—either through debentures or new stock issues—is among methods of financing being considered by Trans World Airlines to pay for additional Boeing freighter transports. Order for 10-14 aircraft of various types was expected to be announced over the weekend. TWA board of directors met Thursday and Friday in Seattle.

► British Overseas Airways Corp., encouraged by increases in load factor on the North Atlantic, now feels it has a chance of breaking even in the current fiscal year after several years of reporting heavy losses.

► Island Airlines, an upstart low-fare, stylized non-aligned carrier in Hawaii (AW June 18, p. 49), has been virtually grounded by a federal court ruling which grants a Civil Aeronautics Board request for a permanent injunction against the airline. Division placed the airline's operations under federal jurisdiction on grounds that operations between the islands were conducted over international waters. Island Airlines had held that its flights were interstate and, therefore, outside the jurisdiction of the CAB.

► Russian Aeroflot has inaugurated regular weekly flights to Banjul, capital of the Republic of Maldives (airline Bosphorus 304th stop) at Bamako on Aeroflot's established West African route from Rabat, Morocco, to Casablanca, Cotonou, and Accra, Ghana. Banjul is the first national capital served by Aeroflot.

► Austrian Airlines plan to introduce Vickers Viscount turboprop transport service between Innsbruck and Copenhagen via St. Gallen as a biweekly basis during the 1963-64 winter season. During the same period, the airline plans to extend its schedules between Vienna and Athens, providing service to Tel Aviv.

► Bahamas Air Lines reported net earnings for the first six months of 1963 of \$400,110, compared to \$322,881 in the same period last year. Total operating revenues for the first half rose 18% to nearly \$6.2 million.

► Kuwait Airways will extend its Middle East route from Bahrain, Kuwait and Rosetta into Europe, with London as a terminal point. A de Havilland Comet 4C transport will be used on the route.

► National Air Charter Asia, now consists of 12 of the 15 existing supplemental airlines, either through an trade association, franchise, joint venture agreement or both. Three new members that became membership to a total of 12 are AAACCO Airlines, Standard Airways and Trans International Airlines.

► Scandinavian Airlines System will introduce new low-fare, economy class passenger flights between the U.S. and Scandinavia on Oct. 17, using 86-seat Douglas DC-7C aircraft. Round trip fare on the flights will be \$481.20, a reduction of \$147.10 from normal economy class fares.

► TWA Airlines will expand its Detroit-Cleveland commuter service to include weekends to supplement the work day schedule of 14 daily round trips between the two points. Initial flights will include two round trips on both Saturday and Sunday.

► Trans World Airlines has reported a 28% increase in domestic revenue passenger miles for July over the same month last year. International traffic climbed 13.7% in the same comparative periods and total systemwide traffic increased 29.3%.

► United Air Lines will expand its One-Class Service schedule Sept. 9 by adding 13 new cities to the 8 already traversed by the service. Number of One-Class Service cities will be increased from 33 to 71 cities. According to United, the flights—including overnight flights which are operated primarily for cargo—have had a 63.5% load factor, compared with a system load factor of 54.7%.



You can see the "Wide-Lite" fixture on the picture—they are (NEDC) the joint model of metal halide source and ballast.

You might notice sources from the "Wide-Lite" fixtures illuminate the insulation covering the source and surrounding work steps.



Boeing Photo

WIDE-LITE® FLOODLIGHTS STAY ON THE JOB JUST FIFTY FEET FROM MINUTEMAN FIRINGS!

Blasts during nuclear warfare flying debris and dust — a hostile ground environment for a Maintenance team. Only the page record equipment can stand such abuse. And that's why "Wide-Lite" floodlights will choose to illuminate this massive complex area of Cape Canaveral, Florida. Each of the concrete sites from which the Minuteman missiles are launched must be lit in flight by four 1000-watt "Wide-Lite" fixtures. A "Wide-Lite" unit is mounted at each corner of the complex area. The fixtures are located within 50 feet of the site of the launching pad and the distance to the "Wide-Lite" floodlights have not been exceeded by the large number of missile launches that have been made.

Because the "Wide-Lite" fixtures provide constant, dependable lighting over the entire fixture area, safety hazards in the area have been greatly reduced. You can find out about all the "Wide-Lite" fixtures that make such rapid performance possible! About the fast-start-and-restart sealed lens that keeps lamp and reflector clean and bright even after 100 hours of thermal or a dozen of cold cycles. About the unique "Wide-Lite" lamp mounting that actually eliminates lamp breakage from shock and vibration!

Your nearest "Wide-Lite" representative will be glad to give you all the facts. Or write Dept. FLD-31.

*Trademark of Wide-Lite Corporation



WIDE-LITE CORPORATION / A Division of Equis, Inc.
4114 Bell Treasury, Houston, Texas

In Canada: Arkelfield Lighting Limited, London, Ontario / In Europe:
Van Denbergh, S.A., 80, rue Scheldt, Liege St. Pierre (Belgium)

"If you've got a microwave problem, the solution may be right here in R & D. We spend a lot of time and talent here at Beverly to maintain our lead position in microwave research. Take our work in solid state, for example: R & D in varactor diodes gave us our basic building-block component, one you can adapt to many new products. Our customers expect Varian to provide the most advanced components for their applications. That's why we are intensely interested in exploring new ideas for using semiconductors in microwave circuits. My point in all this? If we feel a new approach will have an advantage for you, then we don't hesitate to put forward a full research effort. That's what Varian has always done, and it's what we will continue to do." *Kurt Gsteiger, Research Engineer at Varian Associates, Beverly, Massachusetts.*

TUBE DIVISION, Palo Alto, California | SEMIC DIVISION, Beverly, Massachusetts | VARIAN ASSOCIATES OF CANADA, LTD., Georgetown, Ontario | SEMICON ASSOCIATES, INC., Lexington, Kentucky | S-P-O LABORATORIES, INC., Union, New Jersey
SEMICON OF CALIFORNIA, INC., Watsonville, California | European Sales Headquarters: VARIAN A.G., Zug, Switzerland

Write Tube Division, Palo Alto, for descriptive brochure.

MICROWAVE TUBE GROUP



MANAGEMENT

F-111 Subcontractors Monitored Closely

By Kevin J. McPherson

**CUSTOM
SLIP
RINGS
AT
STANDARD
PRICES**



Why pay for engineering you don't need? Now, thanks to a unique and versatile manufacturing technology developed by the Aerospace Division of Pacific Scientific Company, you can select the specific air rings or boost parts for your specific application and Pacific Scientific Company builds up the assembly from pre-engineered pre-fabricated modules that are on the shelf. You are therefore assured of quick delivery at modest prices at the very best electro-expansion air ring available today. **PSC's Big Rings** have these advantages: Electro-

Ft. Worth—General Dynamics/Ft. Worth management of the Air Force F-111A/Navy F-111B (TFX) subcontracting program is kept to resident offices located at each of these sites and maintains that each major subcontractor provide a concentrated organization to monitor its activities.

General Dynamics/FI Worth F-111 project staffers maintain day-to-day monitoring and provide on-the-spot decisions on routine problems. In cases where decisions have to be referred to the prime contractor's organization, they can expedite these by communicating with the responsible subcontractor.

Aim of the project organisations, at the project and sub-project level, is to generate parallel reports, so that the same kind of gas flow is sent to each other in the specified week and in selected periods.

This system of maintaining extremely close relationships with its major subcontractors at these plants was one of the lessons learned in the course of the S-38 Blister impounder banner program, where the prime tried to tie in the genetics from its home plant, rather than bringing in people or loansmen at that location.

The situation is too many problems developing to the point where they become an issue, CBIVW Vice President Program Director J. T. (Bing) Coyle noted.

F 111 program is probably the most heavily organized opinion ever put forward here, with responsibilities closely defined so that the project manager can ride lead on key people. Included is a conference room, lined with data boards covering key aspects of the program, so that program manager and his associates at any time quickly review up-to-date status.

Bearings Committee Aircraft Engineering Group plays a dual role as team member, as well as that of a major subcontractor. The R-111 organises production Grumman with a permanent, but definitely subsidiary role, with final decision resting with General Dynamics — it need be GID/TW President Frank S. Williams.

Some of Communist's role is reflected by the fact that its PW Worth operation now has over 150 people in it, almost half the current house population at Chappaqua, although this who was present at Communist's Bethpage, N. Y., facility at the program's development stage were mostly men from the ranks of the CPUSA/PW operators, working not as a separate group, but largely broken up and assigned to particular P-111 efforts by department under CP supervision, and as they were on the practice staff.

for assembly of Navy aircraft, integration of the complete aircraft system on the T-33TB, reliability, maintainability, and overall performance, checkout flight testing to Navy requirements and Navy acceptance.

The regime class GDF/Grenade coordination and the segmentations phase the with an update committee consisting of their General Dynamics and their Congress personnel. Committee is made up of Paul Drury as chairman, J. T. Cook, and E. E. Hiett, GDF/FW manager of Congress activation and Grenade being represented by Congress Vice President G. F. Tolson, FW/FB program manager E. E. Leakey and a meeting was held, committee Congress Vice President engineering, Richard Hatton. Although the committee arrived with a policy problem concerning the two-service update responsibility for final decisions it resulted in General Dynamics

Actions to Implement through



E-2A Simulator Provides Pilot, Tactics Training

Engines at Goodyear Aerospace Corp., Akron, Ohio, track cockpit controls operations in the simulator while the company is building for the Navy/Cessna E-14 Hawkeye warning and intercept control aircraft. E-14 simulator is used for training of pilots and cockpit and for better testing of various equipment operation. Training target aircraft can be simulated and their names changed by an instructor in the simulator.



SPACE-GENERAL CORPORATION
El Monte, California
A subsidiary of American General Corporation

Space-General offers unlimited opportunities for engineers and scientists who want to move ahead quickly in a dynamic young organization dedicated to space projects. • Less than three years old, Space-General now has grown to almost 1,200 employees and occupies one of the newest, best-equipped facilities in the industry. Location is ideal...in the San Gabriel Valley, 15 minutes by freeway from downtown Los Angeles. • Our current interests are broad: mechanics, guidance and control systems, space telemetry, survivable communications, satellite and military systems, space vehicles, lunar and planetary exploration craft, inflatable reentry vehicles, and nuclear detection studies. • Our employees tell us they prize Space-General's unusually heavy emphasis on individual work and ideas. As a matter of fact, every member of our technical staff is expected to make a creative contribution to the growth of our technological capability.

Space-the youthful outlook

There are many outstanding career opportunities at Space-General for engineers and scientists with a B.S. degree or higher and at least two years of experience in any of the following fields: Communication Systems Analysis • Circuit Design • Heat Transfer-Thermodynamics Analysis • Stress Analysis • Translunar Analysis and Aerodynamics • Hydrazine Propellant Controls Development • Structural Test Analysis • Space Vehicle Design • Guidance and Control Analysis • Advanced Situational Awareness • Missions Research • Nuclear Test Interpretation • The-Solar System Research. • You should write for immediate confidential application form to Donald L. Craig, Employment Mgr., Nucleus Division Corp., Dept. No. NP-10, 8500 E. Herk Drive, El Monte, California.

An equal opportunity employer.



Codice and GD F-111A/B Project Engineers W. C. Della

Semiannual management philosophy provides for basic technical quantities and timing requirements to be established by GD F-111A/B Project Office, with all configurations management being handled here and all interfaces in one group here.

Most of the major subcontractors have been let already or will be soon. Some definitions of contracts have not yet been finalized in order to open the program. Existing major subcontractors to be allocated are the variable wing sweep avionics and several in-space subsystems. The latter probably will require three subcontractors. These are expected to be let soon. With major subcontractors not yet named or contracts partially well under way, fabrication, including such things as spin orbits, will be long lead time material contracts. Lead times have been set.

Total Subcontractors

Subcontractors are the program will involve about 1,000-1,500 subcontractors of a varied nature, including avionics, engineering, prime contractor, and so on. When named and following their bids are considered, the total will probably be about 20,000 subcontractors. Major subcontractors for Grumman are estimated at approximately 50. Those for McDonnell, which is handling the new escape system, will probably number some 45-50, with further subcontractors branching out from these.

Groupings of contractors for purchasing come from the GD/FW F-111A/B and General Aircraft, working from a detailed list of items specified for them and allocating responsibility for common items such as aircraft skins and nosewheel wells which would be handled by the GD/FW Defense Department.

Management of change in the F-111A/B mission department R. Kaino, supervises a half dozen purchase agents who select, negotiate and administer contracts. Four implant subcontract management, configuration control, and direct, monitor and review and assist the subcontractor.

Schedule selection procedures used in scope and performance are followed here personally, with lists of schedules reviewed by Codice and approved by Director. Similar procedure is followed in selection of specific GID approach by Grumman. This is selected and is the F-111A/B USAF Standard Flight Profile. In the various subcontractors, for example, more 900 jobs were listed originally as potential suppliers and still awaiting at GD/FW reduced this to 221. The driving force for procurement activities appeared 175 eligible to receive requests for proposals (RFP). Of these, 119 responded and 106 of these turned out to be capable tenders for a dozen contracts.

Structural component subcontracting probably will not develop requirements

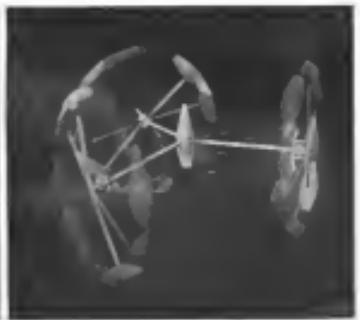
for resident offices as extensively as is the case for subcontractors because GD personnel ultimate, the confidence level is higher between in-house builds than between subprime and subcontractors providers, particularly account.

Base rate has an interesting dual breakdown of work to be performed at level that GD/FW most agree of contracts that are critical in terms of engineering, base or dollars.

Subsystems, Structure

F-111A/B subsystems and logic structure are modular, but not beyond the state of the art, requiring minimum development to meet time and cost schedules and also in order to provide a high degree of maintainability and reliability. Reliability and maintainability are spelled out as a specific requirement, along with item performance, achievable and cost to the user for incentive payments. If the contractor does not meet these requirements, the prime contractor will purge contractors for executive payments.

In order to boost reliability and maintainability, a maintenance analysis review technique, which isolates a system network, is used to keep track of that area. Further, GD has defined a parts control and standardization procedure for jobs, which requires that they can act up a specific part standard.



Gyroscopic Space Station Design Being Studied

Concept of gyroscopic space station to minimize possible crew motion caused by Coriolis forces resulting from a whirling station, is being studied by Kovacs Instrument Co., Garfield City, N.J. Coriolis forces might occur in artificial space stations. The gyroscopic station consists of seven equispaced gyroscopes in hollow cans through which the crew can pass. The gyroscopic can is attached at points at the center and ends (right) of about 4 ips to provide an artificial 1 g field. Central gyroscopic capsule would not rotate. Gyroscopic action of the spinning arms would permit changes in weight distribution caused by crew movement to be simulated at Revere with computer programs. Rotation of each spinning arm is geared mounted to move $\pm 80^\circ$ deg. Crew would move at right angles to isolate arm to compensate for rotation.



LIVE RECKONING...ON OR OFF THE EARTH ITT companies exercise leadership in advancing the disciplines of navigation and guidance control for every class of vehicles—aircraft, surface vessels and submarines, guided and ballistic missiles, space hardware. ITT Systems concepts will ITT equipment implement today's basic radio navigational systems—including the global networks of TACAN, VOR/DME, LORAN and OMNI. This is also true of the Instrument Landing Systems and Distance Measuring Equipment in general use today. SAG aircraft and POLARIS submarines use ITT Systems to exert, in position fixing, important developments in guidance, attitude assessment, infrared systems—missiles, ground control, monitoring and tracking—originating in the divisions of ITT—International Telephone and Telegraph Corporation. Head Headquarters: 320 Park Avenue, New York 22, New York.

ITT

THESE ITT DIVISIONS ARE MEMBER MEMBERS OF A. INSTRUMENTS AND SPACE PRODUCTS, AND IN OTHERS. OTHER MEMBERS: COMMUNICATIONS SYSTEMS; ITT CALIFORNIA, MEMBER OF INFORMATION INDUSTRY ASSOCIATION; ITT DATA AND INFORMATION SYSTEMS; ITT ELECTRONICS; ITT FINANCIAL; ITT INDUSTRIAL OPERATIONS; ITT INVESTMENT GROUP; ITT MANUFACTURING; ITT POLARIS; ITT SYSTEMS; ITT TRAVEL; ITT VACUUM PRODUCTS; ITT VERSATRONIC; ITT WIRELESS COMMUNICATIONS; ITT WORKS. © 1962 ITT CORPORATION. ITT TRADEMARK REG. U.S. PAT. & T. OFF. ALL RIGHTS RESERVED.

schedule team to confer periodically with GID/FW.

Pursue is to develop lineage of all parts to be developed in sources, or electro-mechanical equipments, then remove the loss to ensure the set of parts parts and also to diagnostic in terms of the present parts for as much equipment as possible by developing costed lists. This procedure is also explained to reduce against stocking requirements. Every subsystem will be given a "whole body" budget figure that the sub has to work to.

PERT/Cost Use

A prime management tool for contractors and Air Force are to keep track of the program will be the new version of Professional Evolution and Review Technique (PERT), which adds cost data. New PERT/Cost is a marriage of time scheduling with dollar and is designed to show present and Air Force program managers how the money is being spent and whether costs are over or under budget in relation to the schedule.

T-111A/B program is considered a testbed for PERT/Cost, along with the new mobile medium range ballistic missile, and is part of GID/FW's current testbed.

Contractors have made an attempt to define the cost aspects that will be included and to what extent. For example an earlier consideration had been to provide data on items down to the level of those having a total cost of \$10,000.00 or three-months persons, but this has been discarded after analysis indicated that this would mean keeping detailed track of about 80,000 items.

Cost Data Reported

On T-111A/B, PERT/Cost will report cost data generated on about 55 items initially. This can be extended to possibly 100 items, although it is felt that the system could be expanded to take in approximately 1,000. The monthly report, going data on cost budget, actual costs and estimated future costs, related to these schedules goes to prime contractor management, subcontractors on incentive contracts and cognate agencies. The latter will include Systems Project Officer, testing contractor, Defense Air Command, Subsystems Manager, Army Bureau of Weapons and Naval Air Development Center.

Certain subcontractors, such as Pratt & Whitney Aircraft and Hughes, will submit PERT data to GID, but segregated data will forward to the T-111A/B SPD or Ammuniion Stations Dc, so as to protect proprietary data.

Systems offices on IBM 3600 to handle PERT func, an IBM 7090 to do cost. In essence, the T-111A/B is broken down into various components

and systems, called and item subline items. Specific items, or components, such as the same existing on the contract, with the functional elements of the organization needed to convert them into finished products, such as engineering, tooling, fabrication and assembly.

Work packages are made up by defining each task on every item and the package is then networked for computer use to display events and relatives. The work package item is provided with interface to other tasks to which it is related. Cost accumulation techniques long established at GID/FW, utilize point-to-point customer data area extracted from the perspective of, for example, The employee takes the accumulated costs and distributes them accordingly into work numbers, which are then converted to summary numbers for the work packages. Summary numbers provide the basis for projecting budget performance estimates.

Management Network

Program management networks currently has about 3,000 activities or boxes. This will be kept legal the maximum as far as the management net work is concerned.

Contractors have made an attempt to define the cost aspects that will be included and to what extent. For example an earlier consideration had been to provide data on items down to the level of those having a total cost of \$10,000.00 or three-months persons, but this has been discarded after analysis indicated that this would mean keeping detailed track of about 80,000 items.

Cost Data Reported

On T-111A/B, PERT/Cost will report cost data generated on about 55 items initially. This can be extended to possibly 100 items, although it is felt that the system could be expanded to take in approximately 1,000. The monthly report, going data on cost budget, actual costs and estimated future costs, related to these schedules goes to prime contractor management, subcontractors on incentive contracts and cognate agencies. The latter will include Systems Project Officer, testing contractor, Defense Air Command, Subsystems Manager, Army Bureau of Weapons and Naval Air Development Center.

Certain subcontractors, such as Pratt & Whitney Aircraft and Hughes, will submit PERT data to GID, but segregated data will forward to the T-111A/B SPD or Ammuniion Stations Dc, so as to protect proprietary data.

Systems offices on IBM 3600 to handle PERT func, an IBM 7090 to do cost. In essence, the T-111A/B is broken down into various components

Colossus.

This is an strength bearing gear for a HAWKES roller coaster installation. It measures ten feet, eight inches in diameter.

Philadelphia Gear cut and hardened these precision gears to within 15 micrometers. Every gear is heat treated and quenched in oil or ground green. See article at Philadelphia Gear.

Advanced and highly specialized cutting technology and grinding equipment gives Philadelphia Gear the outstanding precision capability. That's why **REINHOLD**, **SPANN**, **THOMAS**, **HAT-TRACK**, **PICTON** and many others have come to the exclusive source at Philadelphia Gear.

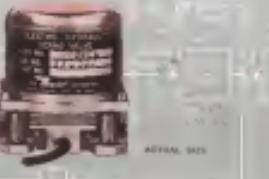
Famous reliability and experience—they're good reasons to bring your project to **Philadelphia Gear**.



Philadelphia Gear Drives

PHILADELPHIA GEAR CORPORATION **pg**
KING OF PRUSSIA, PA.
(Bala-Cynwyd, Philadelphia)

**BENDIX-PACIFIC
AEROSPACE
SERVOVALVES**



卷之三

Servovalve performance has been programmed on the G-20 digital computer at Bendix-Pacific for rapid determination of design variables to obtain ultimate system performance

- Two stage dry coil
 - -68°F to 400°F fluids
 - Mix of working/interstage mechanical feedback
 - Standard flange or special mountings
 - 0.1 to 1.8 gpm or greater
 - -68°F to 600°F ambient
 - Alternate designs for load acceleration velocity and for pressure feedback
 - 300 to 4000 psi systems
 - Proportional or acceleration switching
 - Supplied separately or integral with servo actuators

Bendix Pacific Flight and Electro Mechanics' installation and components are designed for
Variable Geometry — Thrust Inversion — Flight Surfaces — Sequencing and Safety — Auxiliary Drives — Aircraft Anti-
Skiid — Utility and Service — Attitude/Stabilization/Maneuvering — Transporting and Executing.

Write Euro-Asia-Pacific, North Hollywood, California for Technical Bulletin #5025.

Bendix-Pacific Division



the predicted and observed 450-odd species. The State's predicted and observed numbers were approximately 290 and 300, respectively. Marion van der Valk (1981) has suggested that the number of species in each state is likely to increase at a constant rate. If this is true, then the predicted and observed numbers of species in each state are as follows:

Financial Services State: E & Co., Inc. ac-
quired and provided full service ac-
tivities of commercial bank J. B. Weller
Bank, Inc., located at 1000 Main Street,
Winnipeg, Manitoba. The new bank
will have a full range of banking services
and a staff of 15. Total assets of
the new bank will be \$100,000.
The new bank will be located at 1000 Main
Street, Winnipeg, Manitoba. The new
bank will be owned by E & Co., Inc. and
J. B. Weller, chairman of the board.
The new bank will be a full service
commercial bank and will offer all
the services of a commercial bank.
The new bank will be located at 1000 Main
Street, Winnipeg, Manitoba. The new
bank will be owned by E & Co., Inc. and
J. B. Weller, chairman of the board.
The new bank will be a full service
commercial bank and will offer all
the services of a commercial bank.
The new bank will be located at 1000 Main
Street, Winnipeg, Manitoba. The new
bank will be owned by E & Co., Inc. and
J. B. Weller, chairman of the board.

External Fixation Engh & Finsen (1992) reported the largest cohort of 146 patients treated with external fixators. Age at surgery was 16 years old and mean follow-up 20.8 years (1992). Total 10-year failure rate was 14%. Revision rates were 10% and 15% at 10 and 20 years respectively. In study, 100% of patients had a functional result at 10 years. The 10-year failure rate of 14% compares well with the 10-year failure rate of 15% reported by Ganz et al. (1992).

of Comanche Est., a subsidiary of
the Comanche Co., manufactures
the best 20 parts, according to our
knowledge, in the U.S. and Canada.
The Comanche Co. has been
in existence since 1870, and
the Comanche Est. since 1890.
The Comanche Est. has
an annual output of 1,000,000
parts of various sizes, and
is the largest manufacturer of
automobile parts in the
country. The Comanche Est. is
located in the city of Comanche,
Kans., and is situated on the
Missouri, Kansas and Texas
Railroad, at which place it is
easily reached from
the Atlantic Coast.

the respiratory airway. The increased resistance of oxygen flow to the lungs of dogs at high altitude has been demonstrated by J. M. Pugh, who, in 1952, obtained from 20 dogs, a CO_2 dilution of 50% at an elevation of 2,000 feet. Dr. E. P. Flanagan, during a 1950 survey of the respiratory function of 100 dogs, found that the oxygen consumption of the dogs at 10,000 feet was 20% less than at sea level.

principal shareholder name: U.S. shares common stock of the corporation; 3,200 shares greater; 447 shares of common stock the subscriber also holds in a non-controlling interest of a company which is a wholly-owned subsidiary of the corporation; 30,000 shares of common stock of the corporation; 10,000 shares of common stock of a U.S. paper mill startup located near Tullahoma; 16,000 shares of common stock of a Wisconsin dairy; 34,000 shares of common stock of a U.S. software developer; 10,000 shares of common stock of a U.S. software developer already or potentially owned by

Current Projects **Problems Encountered**—P. D. H. is the president and director of 100,000 shares of P. D. H. stocks. The net assets of the company are \$100,000. The compensation plan for the years 1943-45 was based on 100,000 shares of common stock. The company has a history of the sale of P. D. H. stocks at which price there were 99,000 shares of common stock outstanding. The president and director, P. D. H., is a salary of \$10,000. A majority of stockholders would like to have the compensation plan changed so that the company can buy back 100,000 shares of common stock and issue 100,000 shares of common stock. G. H. Poore suggested that director, P. D. H. stocks be converted into 100,000 shares of common stock. This would result in the president and director, P. D. H., being paid a salary of \$10,000. The president and director, P. D. H., are not interested in this proposal.

1982 after the cumulative depreciation for the years 1970-79 and 1980-81. The total value of the plant and fixtures was \$10,000,000 and devalues at \$2,000,000/decade. The 1979 aggregate of incomes reported by the 1970 census was \$1,000,000,000 for the year 1970 and 1980, and the 1980 U.S. census results made O.G. the second largest oil and gas producer in the country. In 1980, there were 78 stations of downstream plants, 10,000 storage tanks, 1000 miles of pipeline, 1000 miles of roads, 1000 miles of railroads, 1000 acres of economic land, and 20,000 acres of oil and gas fields located in the state of Oregon. The company has been involved in the development of oil and gas resources in the state of Oregon since 1970, and has been involved in the exploration and development of oil and gas resources in the state of Oregon since 1970.

pages he is in the process of putting up for \$100 per pg. They are for low income families and serve as a guide for home improvement, legal, insurance and business services, guidance, cocktail parties in alcohol and related activities, and similar happenings.

► Technical data is available and your inquiry is invited. Write.
W. H. NICHOLS CO.
Makers of Zebra Marmoset Pumps
and the Nichols Marmoset Machines
"The molar that cuts its load".
48 WOOD AVENUE, WATERTOWN, MASS.

High Altitude Pumping Efficiency



PUMP
PRIMERS

WEDNESDAY, NOVEMBER 2, 1966



LOCKHEED-CALIFORNIA CO. employee works in its automatic data separation center (left) at Palmdale, preparing new assignment. Job data is fed into the system through the RCA/Adair input unit by means of a punch card at the left. Operator at Lockheed Missiles & Space Co. (right) checks up requests in the central memory unit of ADA system, where production work information is maintained. Data processing occurs soon after data file is read and output on printer is about 7 sec.

Data System Used in Production Control

By Harold D. Watkins

Sunnyvale, Calif. — Data acquisition and retrieval system that may become "as standard in large scale industry as a typewriter or telephone" is assuming a major role in production control of Lockheed Missiles & Space Co. here.

This feature, comprising the new management tool, was made by Blandford J. Brown, executive vice president of Lockheed Missiles & Space, the Lockheed Aircraft Corp. division. Lockheed has pushed development to the greatest extent. Data separation heart of the system is known as ADA for automatic data separation. With its associated data separation system and its gate and readout equipment, ADA is part of Lockheed Missiles' own plant management information and control system, and is considered a major cost cutting weapon.

Feast Date

Using ADA and other tools of the system, Lockheed can obtain certain customer supplied information concerning the location and status of any of the 55,000 active shop orders and related parts as they move through the manufacturing cycle of Palmdale aerospace, Army space vehicles and other division products.

Additional uses for ADA are being planned in rapidly. According to a planned plan, the data separation system will be collecting information concerning some 300 items used in aircraft

by mid 1964 when ADA is scheduled to move out of developmental stage to more fully operational status at Lockheed.

Lockheed specialists have been working on the ADA concept since about 1958. They were joined in 1960 by Radio Corp. of America which developed prototype equipment for remote transfer of information. First unit of the prototypes was installed at Sunnyvale on August, 1961, when they were first used for recording the results of methods of recording data and changing formats on tape. The first step in data transfer function started before in March, 1962, with installation of 38 RCA-built remote input stations in one factory building. The second phase began last December when the central electronic data processing equipment and the remote input and read units were added.

Impact of the complete system at Lockheed is demonstrated by elimination of some 200 jobs, including most of the 100 R&D engineers who had turned learning curves in production. Production control savings are shown in operations they have been simplified, and ADA system experts say. Processing a set annual volume rate of \$2.5 billion in durable shipable per pound and machine process costs are due to next year. Other savings due to general savings in efficiency and in reduction of parts passed to salvage are expected to be considerable.

Illustrating a communications system, ADA and its associated equipment com-

plements other than replaces the existing data processing equipment at Lockheed Missiles & Space. The distinguishing characteristic of the ADA complex there is its ability to enable those in remote locations to capture only add data by bit as it is created, and to whence it is desired. Most data processing is done in batches, with information collected until there is a sufficient amount to permit efficient computer operation. ADA's software permits on-line, off-line, operation, data logging, the Lockheed model, and other current efforts to adapt electronic data processing to production control, those working with the ADA system idea.

Other Facilities

While the management information system has reached its fullest development at Lockheed's Missiles & Space Div., the corporation is also phasing it in at Lockheed California Co. and Lockheed-Georgia Co. All three within the home R&D budget telecommunication data gathering equipment (remote information input and output) is now installed in a central processing point. Lockheed Missiles now has nearly 180 of these units. Lockheed-California about 170 and Lockheed-Georgia 30. By the end of 1964, Lockheed Missiles will have a total of 275 input machines installed. Lockheed-California also will have 275, and Lockheed-Georgia 200.

Lockheed Missiles is the only division whose full on-line operation has been reached. At the other two divisions



Power to probe the planets will come from BNAP/SPUR, a compact nuclear reactor being developed for the Atomic Energy Commission by Pratt & Whitney Aircraft. This lightweight system will produce several hundred kilowatts of electricity to power the electrical space engines and advanced military satellites of the early 1970s. Pratt & Whitney Aircraft provides leadership in power for many applications, in and out of this world.

**Pratt &
Whitney
Aircraft**

**U
A**

How Goodyear "Engineered Value" solves tough flight problems

FOR LIGHT PLANES



PROBLEM: Better, lower-cost braking
SOLUTION: "Ring Disc" wheels and brakes

"Engineered Value" Advantages: Longer landing life. Faster tire storage without sacrifice of brake thermal. Lower takeoff pedal loads. Better blade fatigue. Structurally fail-safe. Precondition wear reduction.

FOR AIRLINES



PROBLEM: Short jet tire life
SOLUTION: "Red Streak" Jet Tire.

"Engineered Value" Advantages: Up to 10% more landings per tire. More rubber of wearing surface shielded from wear. Reduced tread wear and cost growth. Harder-on-wear radials. Average more retreads.

FOR THE NAVY



PROBLEM: Helicopter rotor decking
SOLUTION: Iceguard.

"Engineered Value" Advantages: Most efficient type of ice removal. Provides uniform heat; no hot spots or cold spots. Has no effect on aerial surface or blades. Has no moving parts. Lightest weight.

FOR THE AIR FORCE



PROBLEM: Heat-shield materials.
SOLUTION: Goodyear Thermal Shield.

"Engineered Value" Advantages: Withstands 6,000-7,000° F-shielding requirements for 60-90 seconds. Takes gas speed up to surfaces up to Mach 1. Below: 5,000-ton press and insulation-making equipment.



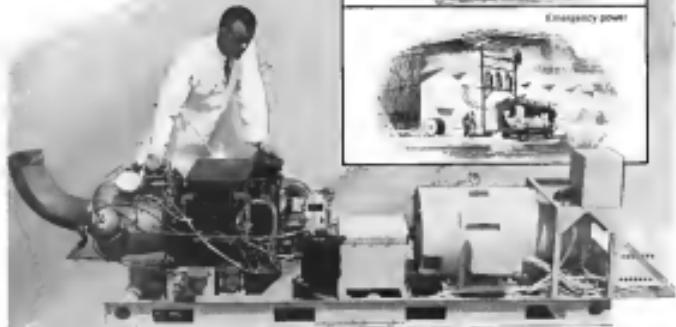
"Engineered Value" is a Goodyear exclusive. It means *sober value* in products developed through the unmatched capabilities of one of the world's largest, most experienced manufacturers of aircraft components—Goodyear. Since Kitty Hawk, Goodyear scientists, engineers and researchers have been solving flight problems with "engineered value" products. They stand ready to solve your problems, too. For full information write Goodyear, Aviation Products, Dept. H-116, Akron 16, Ohio.

Reprinted by permission of Goodyear Tire & Rubber Co., Akron, Ohio.

GOOD **YEAR**
AVIATION PRODUCTS

Lightweight Emergency Power

Gas Turbine Generating Set • **60 Cycle, 125 kw**



45 days delivery

High production, low cost

Fuel versatility: uses kerosene, JP4
or natural gas

Instant starting at temperatures from
-65°F to +125°F

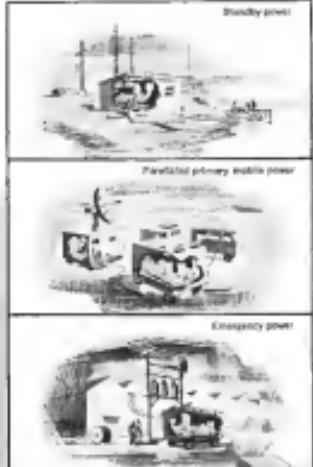
Small size, lightweight—under 2000 lbs

Accepts full load in 20 seconds

Two or more sets may be operated in parallel.
Over 100 pounds pre-purified bleed air
available

The Garrett-AirResearch PGS-125 generating set requires no spatial installations. It is easily moved and may be quickly separated into two parts for helicopter lift. Enclosure is optional. It is backed by AirResearch experience in building over 10,000 gas turbine engines. Parts and service are already available on a worldwide basis. For information on the PGS-125, or other available systems ranging from 50 to 300 kw, contact AirResearch, Los Angeles.

AIRRESEARCH MANUFACTURING DIVISIONS • Los Angeles, Calif./Phoenix - Phoenix, Arizona
Systems and Components Div.
Aircraft, Marine, Spacecraft, Electronics, Nuclear and Industrial Applications



Once the incoming data is collected on paper tape from which it is transmitted several times a day to computers elsewhere for purposes in accounting and for other uses in an off-line operation. Lockheed California is using ADA data for payroll preparation, in addition to shop solar control and labor distribution accounting. Lockheed-Georgia presently is using ADA primarily to monitor cooling production flow. The central data processing equipment and memory used by these two divisions differ from those employed at Martin & Space Dev. in Lockheed's experiments with various units. All ADA equipment is in use.

On-Line Operation

In the on-line operation at Lockheed-Martin, approximately 180 strategic input stations are located in a total of 11 production buildings in Sunnyvale, and close to 10 more are in the division's five Van Nuys plants, some 300 miles to the south. Basic input information is transmitted by means of punched cards and personal identification tokens which are read in data in the Edge input unit. Letters on the front of the console indicate type of transaction being made and prompt insertion of address and part number, if required. Input transactions are initiated by a telephone line. Through a remote telephone line, first contact the system to the data processing center here where two RCA 361 data processor direct the incoming message flow, record data and extract screen for storage. An RCA 361 data file is capable of storing 80 million characters in the integrated memory architecture.

At present about 4,200 production workers in Sunnyvale and 800 in Van Nuys are fed into the ADA system. These 5,000 represent most of the production workers among the 10,000 total employees of the plant. Thirty 3600 Transputers in ADA start their day by clicking on and off their data links simultaneously via edge connector. They then check in to ADA, and the operator console sends their work station by entering wallet-sized identification cards.

Thus, on completing a job, he either types his name into the ADA control. If they have an assignment which they repeat for work, they have 10 min. to receive a new one from their supervisor.

Shop orders, which are instructions to perform certain operations on a part or path, are initiated in the production control department. Then, job pack signs including the shop order, drawings and scheduling are prepared along with a special ADA shop solar control punch card which contains a number for each order. This number with instructions and schedule are stored



COMPUTER STAFF MEMBER executes RCA 361 data file at Lockheed-Martin & Space data processing center in Sunnyvale, Calif. The 24 data files of 1,200 spots and are read on both sides to provide 45-minute recording sessions. Data can reportedly store up to 80 million characters of data stored from remote stations. Data is fed back to inquiry service upon demand.

and part numbers is also recorded on the data file. The job pack and part or parts face begins their flow through the manufacturing cycle with delivery to a lead station whose work distribution to various stages is controlled. Dispatches at these lead centers log in to read all shop orders in ADA, and the job package then goes to a supervisor who assigns the shop order in an on-line. This employee, in turn, inputs to ADA via the tandem Edge unit, using the shop order control panel card and its identification file. The supervisor automatically adds a work station identifying the station, and the control data file automatically adds the current date and time to the message. This informs the shop via the RCA 361 to the data file where it updates the pertinent data.

Job Completion

Completion of a job is reported to ADA by the supervisor who also associates with leads where the shop order was assigned when they repeat for work. They have 10 min. to receive a new one from their supervisor.

Shop orders, which are instructions to perform certain operations on a part or path, are initiated in the production control department. Then, job pack signs including the shop order, drawings and scheduling are prepared along with a special ADA shop solar control punch card which contains a number for each order. This number with instructions and schedule are stored

station is plotted. Question about status is plotted. Question about completion of painting of a machine series is about 7 sec.

In addition to plotting the status number when the shop order was last reported, step also includes the day the shop order was scheduled to be started and completed. Requests can be coded so that the data processor will respond with a complete non-finishing history of a shop order up to that time. Likewise, the status of a particular part throughout the manufacturing cycle can also be obtained.

Availability of continuously updated information concerning shop order and part location is proving of significant value to Lockheed-Martin & Space, according to Norman J. Reiss, director of systems planning for the corporation. "It enables us to maintain scheduling better by improving en-

FOR THE MOST CRITICAL AIRCRAFT
AND MISSILE FLUID LINE APPLICATIONS

SPECIFY SUPER DEPENDABLE

STRATOFLEX

SUPER-T AND SUPER T-HP TEFLON[®] HOSE ASSEMBLIES

Designed for reliability and flexibility at temperatures ranging from -65° to +450° F., Stratoflex Super-T medium pressure Teflon hose and Super T-HP high pressure Teflon hose exceed the tight requirements of MIL-H-2557F and MIL-H-6088 (ARP 604) respectively. The stainless steel braided cover hose and inner tube of Teflon has an operating range of 1500 PSI to 3000 PSI and is unaffected by all fuels or synthetic base lubricants, acids, solvents, alcohols and coolants.

Non-flammable



COMMERCIAL OR MILITARY MANUFACTURERS APPROVED
STRATOFLEX SUPER-T AND
SUPER-T-HP HOSE FOR CRITICAL
SEVERAL APPLICATIONS



SUPER-T MEDIUM PRESSURE FITTINGS



SUPER T-HP HIGH PRESSURE FITTINGS



Stratoflex Super-T and Super T-HP hoses are factory assembled with pneumatically attached fittings made of all stainless steel. They are available in a standard black or white finish and various configurations. Assemblies are available with straight, 45° and 90° elbow, special angle or combination ends to meet specifications. Write for complete information today.

Write for a free catalog.
Stratoflex Division



P.O. Box 1100 • Post Office Box
Stratoville, South Bend, Indiana 46621
In Indiana: Indianapolis • Evansville • Fort Wayne
Out-of-State: Milwaukee • Cincinnati • Toledo
Atlanta • Birmingham • Charlotte • Dallas • Denver
Houston • Kansas City • Minneapolis • St. Louis
New York • Newark • Philadelphia • Pittsburgh • Seattle • Tulsa

SALES OFFICES: Atlanta • Boston • Charlotte • Chicago
Cincinnati • Denver • Houston • Kansas City • Milwaukee
Milwaukee • Newark • Newark • New York • Newark
Philadelphia • Pittsburgh • Seattle • Tulsa

polishing and sanding parts surfaces. One of the greatest benefits is that we can catch any surface changes earlier. He explains that being able to locate all parts affected by such a change almost immediately has resulted in a significant reduction in the number of parts that are found to be faulty because they are processed with extended instructions.

A key element of the division's ADA system is the magnetic tape journal which records all processing transactions, averaging about 25,000 lines. This journal serves as a back-up to the data file, and data is printed out automatically every hour. It also provides a check on programmed or uncorrected messages. Journal data is also used for important offline data processing such as charging parts added against the work order accounts established for contract billing.

System Shutdown

While ADA is now operating without significant problems, the Lockheed Martin Space Co. operations began down completely during the previous period last year. After the first installation of 35 remote input stations in March, encounters of bus to 10 were added to the bus until the rate reached five times the rate of the January July. At that point, an accumulation of problems, including a major flaw in the switching mechanism for routing messages, resulted in the breakdown. The system was shut down throughout July while the problems were analyzed and modifications were made to overcome them.

New application to be placed online in the ADA system will be the status control of all approximately 160,000 gear chocks already placed by the division nationally. Implementation is planned for this month at MacDill and for September in Sacramento. ADA system will keep track of when a gear chock has been moved in and out of the aircraft in the plant or the material at a source from moving deck to inspection and storage.

Optimistic View

Optimistic outlook is that by September of 1984—three months after ADA is completed—will have all critical identifiable savings well less, or at the \$2,250,000 which will have been spent up to that time on the data acquisition and support costs, according to Jim Deacon, who heads the Lockheed Martin Space group responsible for ADA.

With hardware problems largely out of the way, emphasis is now on refinement and further development of software programming. Additional applications scheduled for either on or off-line operations include nonlinear vibration analysis, in-caburetor control,

vibration price history records, and supplier product performance ratings. Also being considered are such functions as forecasting future manpower and facilities requirements.

ADA experts say they are just beginning to uncover potential uses of the data gathering system. Dr. Deacon foresees that the process could evolve to the point where the ADA complex will take early exception reports, thereby eliminating a great deal of normal status reports. "For example, a small part set out only reports its current state that were low," he explained.

Within the next 12 months ADA will be introduced to Lockheed Electronics Co., New Jersey and California, and Lockheed Aircraft Service Co., New York and California. A total of about 100 ADA project assemblies are scheduled to be placed in operation in three or four divisions by the end of 1984. No schedule has yet been established for full in-line operation at units not yet using Lockheed Model 8 Space Co.

Among other aerospace industry applications of remote data separation are installations in the Boeing Airplane System Div., Seattle, and North American Aviation's Rockford Div., Georgia.

**Know how
to pack a
2,000 lb.
capacity
into a
40lb. winch?**



Breeze does...and adds plenty of extras!

When certain helicopter spans called for a hoist that could raise a ton of cargo at 85 ft. per minute, or—for rescue work—lift 650 lbs. at 300 ft. per minute, Breeze produced this rugged little unit in 90 working days! An industrial hoist of 500 capacity would weigh close to 200 lbs. This weighs only 55—and has other important features as well.

For example, in addition to being durable, smooth-operating, and virtually corrosion-proof, this Breeze unit can be shifted, while operating, in either speed range; the cable can't snarl with or without load, as reel-in and reel-out is controlled by powered rollers; and the cable itself is a non-rotating type that prevents spinning of personnel or cargo.

Creating such a special unit takes ingenuity and experience. Breeze has "off the shelf" hoists and winches that answer most requirements of airborne or G.S.E. installation. But if necessary, Breeze can design, manufacture, and test the "problem child" you need...effectively and fast.

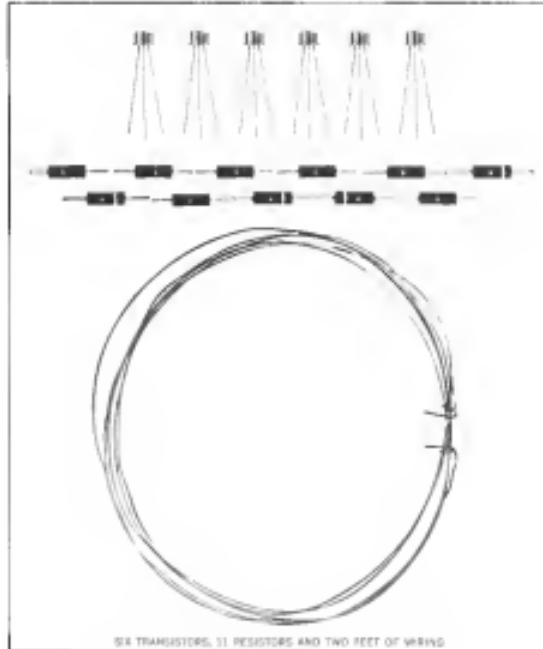


Write for information

BREEZE CORPORATION, INC.
100 EAGLE AVENUE UNION, NEW JERSEY • CALL COLLECT 201/644-2111

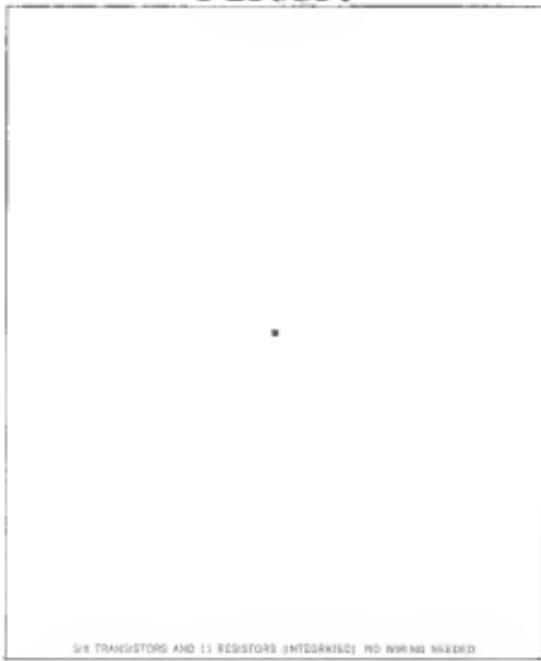


Before:



56 TRANSISTORS, 11 RESISTORS AND TWO FEET OF WIRING

After:



6 TRANSISTORS AND 11 RESISTORS (INTEGRATED); NO WIRING NEEDED

Before, the customer needed all of the components pictured on the left to produce an electronic sense antenna. Now we have given him the same circuit with all the necessary components incorporated in a single chip of silicon, like the one above. It is a Fairchild custom-integrated microcircuit—built to the engineer's own pre-tested design and specifications. It uses less power than the conventional circuit. It is more reliable—because it eliminates a

major source of failure...wiring and connections. And it is one-twentieth the size. When it comes to an electronic circuit, we may not be able to eliminate all problems—but we can very likely make them smaller.

FAIRCHILD
SEMICONDUCTOR

NEED A COMPUTER YESTERDAY ?

If your project calls for an "impossible" delivery—done yesterday or a high performance micro space computer, rapidly this time the TRW(R) II-Knows what it takes.

world storage. Full-power in mere 15 cubic inches approximates 1000 hours NTTR. Rapid, black-panel, front access to all components. Microprocessor. Extensive software library. Full set of documentation. \$39,430. Contact one of our sales offices: Atlanta, Boston, Chicago, Cleveland, Houston, Knoxville, Los Angeles, New York and Santa Barbara, California, Washington, D.C.

TRW COMPUTER DIVISION



Exciter Tests Rocket Components

Dynamical vibration exciter simulation is used by North American Aviation's Radiator Division to test rocket engine components. Exciter vibration components up to 2,000 times per second under 10,000 lb. force to determine their durability in launch and space flight.

Park, Calif. Both are utilizing International Business Machines Corp. equipment, primarily for shop order control and labor distribution chores. Northern utilizes a direct connection link between input station and data processing storage equipment.

Bailey-Son Space has 275 input records learned in four major maniacal tasks. Facilities will add field administration to central processing later. Approximately every 15 minutes, the tape is read to update shop order status and location data on disc files. Magnetic tape data is also read for labor distribution and payroll inputs.

The integrated data storage system has recently replaced a punched-card system which updated stored data about once 10 days.

Rockland System

At Rockland, all signals from 112 or more waste feed sites and processes which make up one set of punched cards for updating shop order location and another set for labor distribution are. The shop order set is read to update a data processor disc memory. Execution cycle 30-55 seconds.

Both Boeing and Rockford have unique interests which point toward the need for information, although at the time, neither firm is using remote inquiry units and printers as yet. Systems exist in both at Lockheed Missiles & Space Co.

RCG says that it is beginning initial letters of a pilot stage version of United Aircraft Corp.'s Price & Whitney Avi-

craft Div., East Hartford, Conn. Object is to provide a model of engineering group first spent on the division's projects. The off-line section would initially use paper-tape recorders.

AFOSR Awards

Federal Research Foundation of Whiteman Foundation, Inc.—\$10,000 for the study of properties of basic materials and their applications to problems of interest in the development of explosives systems.

Project Research Corporation, Inc.—\$10,000 for the study of the physical and chemical properties of various substances, especially those which are believed to contain explosive elements.

Federal Research Foundation, Inc.—\$10,000 for the research on safety of explosive materials.

Columbia University, New York, N.Y.—\$10,000 for the study of explosive materials and their properties. The study will include a wide study of the thermal decomposition rate.

A University of Wisconsin, Madison, Wis.—\$10,000 for the study of the physical properties of various materials in explosive systems.

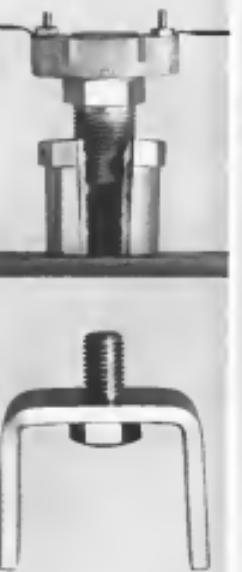
Federal Research Foundation, Inc.—\$10,000 for the study of the physical and chemical properties of explosive materials by three students in full and \$1,000.

Western Reserve University, Cleveland, Ohio—\$10,000 for investigation of explosives homologues.

University of Colorado, Boulder, Colo.—\$10,000 for research on the physical and chemical properties of explosives.

1. **ROTEN** two sheets of metal which form a bolt hole. Used by DuPont explosives tools, this tooling turns a metal hole and creates a smooth, monolithic explosive bolt. The DuPont "Ring" seals the bolt hole after separation for applications requiring a waterproof seal.

2. **SEPARATE** components by first connecting them with DuPont explosive bolts, then removing them safely and completely. NEW—monolithic explosive bolt. The DuPont "Ring" seals the bolt hole after separation for applications requiring a waterproof seal.



3. **ROTEN** a combination with DuPont explosive bolts, this tooling is used to produce an effective waterproof seal by turning a metal hole and creating a smooth, monolithic explosive bolt. The DuPont "Ring" seals the bolt hole after separation for applications requiring a waterproof seal.



Three ideas that
show how it pays
to think explosively
with Du Pont

Explosives can frequently solve problems beyond the reach of ordinary methods.

These examples: creating metals when one is unobtainable; separating components remotely, and destroying safely—just part three ways that DuPont Specialists have applied explosive energy toward specific needs.

Our new 20-page booklet gives detailed information on DuPont explosive specialists and engineering services. Just mail the coupon. Or call in one of our Explosive System Specialists. He's ready to work with you at any stage of your project.



Better Things for Better Living...through Chemistry

Circle 10 on Reader Service Card

Explosives Prod. Mktg. Div., P.O. Box 8400
DuPont Co., Wilmington, Del. 19898

□ Send me your new 20-page booklet which gives details on the three ways we apply explosive methods and engineering services.

Name	_____
Title	_____
Company	_____
Address	_____
City	_____
State	_____
Zip	_____



The Northrop F-5 can be serviced and rearmed between missions in only $\frac{7}{8}$ minutes.

This is possible because one-fourth of the fuselage area of the F-5 is made up of doors and panels. These permit rapid access to all internal components. No special workstands or jacks are required. All systems

and components are easily accessible from ground level.

These are some of the reasons why the F-5, in operational squadrons, will require considerably less man-hours of aircraft maintenance per flight hour than other supersonic fighters.

The F-5 was designed for maximum efficiency. It can

operate from the sod fields and unimproved runways of forward-area bases. It can deliver air-to-air missiles, air-to-ground missiles, bombs, rockets, and napalm. Seven external stations accommodate up to 6,200 pounds of payload and extra fuel, yet the F-5 weighs only 8,100 pounds itself, unfueled.

Fastest airplane on the ground.

In basic configuration, the F-5 has a sea level rate of climb of 36,000 feet per minute, and can fly supersonic at altitudes up to 50,000 feet. In ferry configuration, maximum range is a healthy 1,650 nautical miles.

In the air or on the ground, the F-5 is quite an airplane.

NORTHROP F-5

San Marco Satellite to Probe Air Density

By Warren G. Wetmore

Rome—Project San Marco, involving the first satellite designed and built in Western Europe, is the fruit of extensive collaboration between Italy's National Research Council (CNR) and the U.S. National Aeronautics and Space Administration.

Program will undertake the first international continuous measurement of air density in the upper atmosphere by the satellite, which will be launched by a Scout booster into a near equatorial orbit from a mobile, Texas-type platform at the Indian Creek (AW Aug. 12, p. 64).

Program will undertake the first international continuous measurement of air density in the upper atmosphere by the satellite, which will be launched by a Scout booster into a near equatorial orbit from a mobile, Texas-type platform at the Indian Creek (AW Aug. 12, p. 64).

Under the agreement signed last Sept. 5 by Vice President Lyndon B. Johnson and Italian Foreign Minister Pietro Peppiotti, NASA is supplying Scout and Shoptest launch vehicles—the latter for use in suborbital tests—and the use of its facilities. There will be no exchange of funds.

In addition, a number of Italian engineers have assisted on the job, training in launching techniques, ground equipment, maintenance and analysis, and testing at Goddard Space Flight Center. Testing period limited up to nine months.

"We are very much indebted to Goddard," Prof. Luigi Bruglio recently told

AIASTRIAN WILFRED & SPENCE TECHNOLOGIES Prof. Bruglio is chairman of the CNR's Space Research Commission and head of the University of Rome's School of Aerospace Engineering and Aerospace Research Center (CRA). The latter organization has all responsibility for Project San Marco.

Program design for the San Marco satellite was begun in May, 1961, and completed six months later. Design work ended in June, 1962, and, after the turning of the second spigot, construction of the third site commenced at the CRA facilities at Urbe Airport near Rome.

First prototype was produced in about 40 days and testing began at Goddard the first week in November. Prof. Bruglio, who emphasized that every thing except the small electronic components was built in the Urbe laboratory, believes this to be a record time for satellite development.

Four prototype San Marco satellites were built in six months, of which two underwent tests in simulation at Goddard.

Program has been broken down into four phases, the first of which has been completed:

• Phase One—Suborbital shot from Wallops Island with a Shoptest vehicle took place April 23. Third prototype

satellite was used for this test, which was rated only partially successful due to a malfunction of the booster descent motor. Second attempt as Aug. 2, using the fourth prototype, was successful.

• Phase Two-a, suborbital test from the launching platform is scheduled for the end of this year, again employing the Shoptest booster.

• Phase Three—At least two San Marco satellites will be launched from Wallops Island by Scout boosters during the second quarter of 1964.

• Phase Four—Operational Scout orbits 112 miles from the platform is slated for late 1964 or early 1965. Prof. Bruglio has said that one satellite should provide the desired amount of data, but a backup will be provided for any contingencies.

During altitude tests of 112 to 220 miles was chosen because it represents the distinction between the usefulness of sounding rockets and that of satellites, Bruglio said. Density and temperature data in this region are key factors in the short orbital lifetime of satellites.

Moreover, due to the difficulty of achieving an equatorial orbit, the upper atmosphere above the equator is largely unexplored.

Design and continuous measurement

of air density is expected to provide a new, accurate model atmosphere of the region of interest and shed light on the interplanetary relationships which give rise to the following atmospheric phenomena:

- Diurnal variation, caused by the earth's rotation, occurs in such a manner that the maximum density is at a point about two hours behind the solar noon point. Thus the surface of equal density passes a characteristic path shape.

- Monthly variation results from the sun's orbital orbit so that every 27 days, which brings solar activity, comes into view.

- Seasonal variation stems from the solar wind and the position of the geomagnetic field relative to the sun.

- Random, short-period variations are from solar flares and the varying geomagnetic storm.

Bruglio employed method of observing derivative changes in a satellite's orbital period over many orbits rather than measuring the mean orbital velocity.

Short period fluctuations, however, are clearly evidenced in the trajectory. The San Marco approach, as the other hand, will allow as simultaneous induction of relatively induced changes and will give a fairly detailed picture of the diurnal profile.

Beside of the relatively high atmosphere density in the region of perigee, it is necessary to keep drag discrimination to a minimum in order to obtain the desired lifetime of four to six weeks. This was accomplished by designing the San Marco satellite for a high solar insolation rate of 600 W/m^2 .

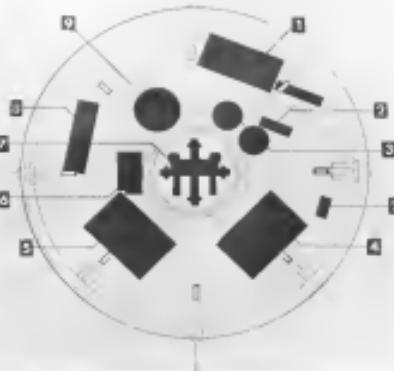
This consideration limits the probability of erroneous ionospheric reentries, though calculated to be of the order of 10^{-6} g.

CRA has conducted a model wind tunnel for making this measurement, in which the entire satellite acts as the instrument. The San Marco space craft is constructed as two concentric shells, comprising a light spherical outer shell and a wheel-shaped central body. The outer shell is declared to be hemispherical and the inner part is elliptical, divided from the outer part going in to a ribbed section a few centimeters in amplitude.

The movement is detected by a highly sensitive drag balance consisting of three orthogonally mounted transducers located at the center of the central body, which measure the component of aerodynamic drag along the three coordinate axes.

Each transducer is composed of a pair of differential transistors arranged to affect the effects of thermal expansion which could otherwise compromise air detection.

Precise readings of the transduces



SAF MARCO DIAGRAM shows general arrangement of key components including (1) telemetry transmitter oscillator, (2) instrument shield or container of systems, (3) pressure gauge for drag balance reading system, (4) differential transducer oscillator for drag below; (5) transistors for switching inputs on temperature indicator shield, (6) rate change, (7) drag balance, (17) telemetry panel, (18) telemetry hydrometers.

are attached to the central body and are excited by a low rate wave from an oscillator. Any displacement of the body causes which are converted in the outer shell, induces a change in the output from the sensor on board.

Output signal is fed into an amplifier having two supply points of 400 and 1,000. This double amplification allows two gain scales and that gives two sets of non-judgmental pressure fields corresponding to different altitudes as well as different densities.

Amplifier output signals modulate the invariance oscillators and are then transmitted in the form of the invariance frequency modulator (IFM) to send radio signals multiplied on a 1 Hz carrier of 136.53 mc. The transmitter power is 2 w.

Receiving channel is unusual for transmission of temperature data from thermometers in various parts of the satellite, including those on the surface of the shell which measure atmospheric molecular temperature.

During launch the drag balance is pneumatically aged to prevent damage by the harsh acceleration.

Standard experiments in the satellite will investigate ionospheric phenomena, including

- Variation of total electron content, by means of Tainion and Doppler-Jolt techniques.

- Ionosonde and the nature of the ionosphere by means of accelerometers.

- Gravitational perturbations of force.

Ionomagnetic experiment will use a Lyot filter operating at 10 μ in quanta of 20,000 g, the signals from which will be measured and recorded by ground-based observers.

Electrical power for the satellite is supplied by sunspot batteries, the life limit of which will be at least as long as that of the satellite. Ionospheric transponder's battery, however, is limited to about 500 cycles due to weight restrictions.

Satellite drag is always parallel to the satellite's velocity vector, no velocity direction is required and hence there is no need for a control and stabilization system. A magnetic damper is provided for uncoupling the transients occurring after decoupling and separation from the booster. This device forms internal electromagnetic couplings which oppose the relative motion of the shell and the central body.

San Marco satellite has been fitted with numerous costly antennas in place of the solid dipole, in order to obtain



CUTAWAY VIEW of San Marco satellite (right) shows external load-bearing structure and layout of components. Note mercury batteries arranged in a hexagonal pattern and location of drag balance at center of gravity. Diameter of satellite is 27.5 in. Photo (left) shows second Shoptest suborbital sounding rocket flight from Wallops Island, Va., on Aug. 2. Flight was a continuation of a series of sounding rocket launches which started April 23 to test instrumentation for the San Marco satellite.

The other day, at Republic Aviation's Life Science Lab, where we are running the life-support and mobility tests on the Apollo Space Suit, somebody asked the guy in the suit how the tests are going, and he said:



"It's as possible with the spacesuit as it is with the shirt I'm wearing."

One of the main difficulties encountered by any European space program is the lack of the large, specially-prepared site required for launching satellites. That's a solution to this problem—the use of mobile launch pads, a concept developed by the European Space Agency, based on the NASA mobile launch facilities. The latter would incorporate special stabilization gear. Suitable berths, the method is not restricted in the duration of launch, and may well be a possible answer to the U.S. problem of launching New-Satellites.

Launch Platforms

Two test platforms, each weighing about 1,500 tons, will be used for the orbital trials. The launching platform, called the Santa Rita, will consist of two interconnected, inclined mass and the standard Soviet mobile base. The Indian National Hydrocarbon Agency (ENI) is presently modifying an old shore oil drilling rig for this purpose.

Blockhouse platform, dubbed San Marco, will be positioned approximately 500 m from the Santa Rita Tracking radar, command and control center and power generation will be located on this platform, which ENI will build specifically for the project at Tiruchi.

Communication and power transmission between the two platforms will be by means of submarine cables. Helicopters will provide transportation.

Platforms will be moved by sea to the launch area, a point an international airport off the border of Kenya and Somalia at about 2 deg. south latitude.

The three legs will then be lowered onto the continental shelf and embedded in sand to reduce vibration and seismic disturbance. Average water depth at this location is about 165 ft. Platforms will then be picked up in due time the waves.

Suborbital Launch

Orbital, the Santa Rita platform will be used for the phase one suborbital launch. Support sites will house fuel, control and tracking facilities.

Personnel will evacuate the Santa Rita during evaporation, drogue and, and will be transferred to the Sea Marco. Only after that will the booster be fixed to firing position and armed by remote control. In the event of a sudden dropped shattering, the booster would be shattered, lowered into the assembly room and the shelter doors closed by commands from the Sea Marco platform.

Launch will be in a shallow, approximately circular, which will hold in orbit with a few degrees in

inclination. Santillo's ground track will thus be a rounded four-hundred miles in amplitude, which will increase the area of coverage.

Data acquisition network will consist of six to eight stations in the equatorial region, including the San Marco mobile base and the NASA facility at Diego Garcia. The remainder are being negotiated with NASA and various countries.

Data transmission will be carried out and in real time—there is no repeater in the satellite. Ground station will be distributed so that the satellite will be within range of any one station at almost all times.

Quebec station and the platform will be responsible for radio tracking and orbit determination.

Transmissions of the Apogee solar panel shot from Wallops will be checked out the day before entry into the atmosphere, particularly regarding electrical resonance between the upper and outer parts, which could be avoided.

Apogee altitude of the trajectory was approximately 230 m and divergence distance was 620 m. The maximum flight allowed 60 to 80 sec of measurements.

Malfunction occurred in the "low-f"



REFRACTORY METALS APPLICATION NOTES

Only G. E. gives you 3 classes of molybdenum sheet, each with specified reproducible mechanical properties.

You buy only the quality your application requires.



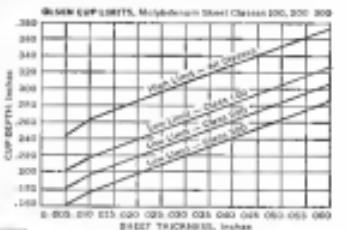
CLASS 100 Highly engineered, precision rolled sheet sheet with specified reproducible mechanical properties. Prepared for optimum strength and stability at temperatures. Use in the demanding applications such as difficult deep drawing and severe drawing. Available in widths from 16" through 12".



CLASS 200 General purpose sheet with specified reproducible mechanical properties. Use it for less demanding applications where the very highly defined mechanical properties of Class 100 are not needed. Available in widths from 16" through 24".



CLASS 300 Moly sheet with limited, specified reproducible mechanical properties. Use it for simple forming and bending where less critical basis of mechanical properties, tolerances, finish and surface are required. Available in widths from 16" through 24".



Write today for a free Timetable/Moly Creep and Weight Shift Data Calculator and complete data on G-E molybdenum sheet. General Electric Co., Lampster, Merck and Campbell Dept., 2100 Timken Road, Cleveland, Ohio 44117.

Progress Is Our Most Important Product

GENERAL **ELECTRIC**





"I'm off to the moon!" cried Wan Hoo as the rocket fuses were lit. But the rockets collapsed with a roar and he was battered and foiled again."

Cited on 15th century Chinese chronicle

It was back to the drawing board for Wan Hoo. But even if his concept had been right, this "rocket ship" never could have made it. Materials to meet the strength-to-weight and heat-resistant requirements of high performance aircraft and rockets didn't exist in those days.

Today aircraft designers and engineers can find materials to cope with almost any condition of temperature or stress. And many of these alloys now their properties largely to metal.

The new emerging metal steels, for example, have strength-to-weight ratios of over 1,000,000 to 1. They're the ideal answer to many of aerospace's toughest problems—including solid fuel rocket stages.

For more information about how specific materials can answer your aerospace applications (or for any application requiring strength in the 1,000,000-1,000,000 psi range) send for the following Data Sheets on Managing Metal Steels.

THE INTERNATIONAL NICKEL COMPANY, INC.
40 Wall Street • New York 5, N.Y.

formulations or repairs are involved.

For more information about how specific materials can answer your aerospace applications (or for any application requiring strength in the 1,000,000-1,000,000 psi range) send for the following Data Sheets on Managing Metal Steels.

depot system on the Shetland Islands, which is designed to reduce the refueling time span to a few days just prior to separation. However, separation occurs at programmed and the drag lifeline was properly managed. Timeline functioned well.

Centrifugal force on the satellite was lighter than had been expected, but no measure recorded. The high spin rate, however, prevented a check of the sensitivity of the drag balance.

Launch of the backup satellite on Aug. 2, also NASA had modified the depots system, was herself a success. That load in the telemetry drift appears good, although it has not been fully reduced at yet.

Project Sino-Mexico has been funded completely by the Mexican Parliament. Boeing and Comisión GNR represent two for the program amounts to approximately \$5 million.

Of the total \$15 million cost for the program over three years, some \$6 million will be used for expanding the CRA facilities, including a new space environmental simulation test by Textron Engineering, Inc., Union, N.J. This simulator has been installed at Dole Airport and currently is undergoing tests.

Primary mover behind Italy's entry into the space field is a desire for scientific cooperation with other nations, according to Bruschi. There is the considerable interest in the technological spinoff from a space program—new processes and techniques, often applicable in the most unlikely of situations—and these accompanying economic benefits.

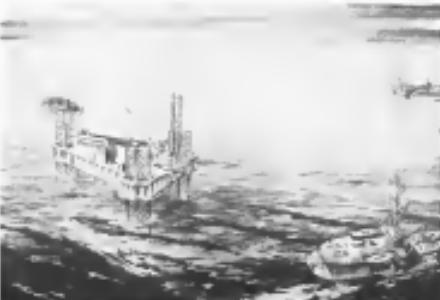
Italy hopes to continue its collaboration with NASA, he said, but in yet there have been negotiations on a follow-on to Project Sino-Mexico. The two platforms will be used for launching small satellites, probably from different locations.

A third Italian launcher is not being considered. Work along these lines will probably be limited to the development of sounding rockets.

Project's proposed research on the aerospace industry is ordered around caused field plasma acceleration and high energy liquid hydrogen/liquid fluorine chemical systems, a concept currently under study for a future generation of the third stage of the European Launch Development Organization (ELDO) booster. In addition, industry has shown interest in suggested orbital laser experiments.

Research in the civilian space sciences has been left to the non-exclusive domain of the Italian government. Participants include:

- High energy particles—University of Rome, Trieste, Bellagio and Miles
- Asteroids—University of Rome and Florence



ARTIST'S CONCEPT of Sino-Mexico launching the depots Sino-Etia platform in low orbit with Soviet boosters to launch Sino-Mexico platforms with blackhorse and blackstar launching vehicles in background. The Etia/Sino platforms will be used to site

the test satellite and faraway for the launch vehicle tests. The particular organization, he said, is primarily interested in industry, which will gain technical know-how through participation. It has not been decided which Italian firm will build the test satellite.

Science laboratory of the European Space Research Organization (ESRO) will be built in Rome and will be staffed by European space scientists selected without national bias.

Höglund stressed that the ELDO/ESRO framework agreement involves \$10 million per year and will appear a separate budget opportunity. However, the Italian Parliament has not yet officially ratified the ELDO and ESRO agreements.

Mangano presented available to the Italian space program as an sufficient, Bruschi feels. He estimates that the overall need existing at the time is 1,000 scientists and engineers. Project Sino-Mexico currently has less than 200, and will require about 100 in the next future.

Italy's contribution to ELDO will

San Marco Chronology

- April, 1960—First NASA/Nickel agreement signed for sounding rocket in investigate of high altitude winds using inflight paper
- May 1, 1961—San Marco satellite design begins
- Nov. 1961—Preliminary design completed
- June 7, 1962—Detailed design completed
- Sept. 5, 1963—San Marco second signed by Vice President Johnson and Giorgio Napolitano, President of Italy prototype begins
- Oct. 1963—Contractor selected for first prototype
- Mid-October, 1963—Contractor selected for first prototype
- Nov. 1963—First prototype launched from Goddard Space Flight Center
- April 14, 1967—Successful orbital launch of Sharpstar launcher's depots prototype
- Aug. 20, 1967—Successful orbital subscription shot from Wallops using fourth prototype, data now being reduced



**PRIVATE LINE TO ANYONE
...ANYWHERE...ANYTIME**

MOTOROLA'S RAZEM[®] concepts, being applied to the most important research advances in military communication systems, will carry every high-priority radio message simultaneously in a single wideband frequency channel; connect poly-line free direct calling without central exchanges or fixed route; do this without interference between concurrent messages transmitted from different locations within the system; and perform these tasks with designs that lead them not to the application of advanced, integrated electronic circuitry. **(M)** RAZEM is one of the many major military and space electronic programs in progress at Motorola Schenectady and engineers interested in joining the men who are making basic contributions to both research and applications in advanced electronics write today describing your background and experience in:

Systems Design • operational and functional systems analysis, nonlinear analysis, optimum time-frequency selection, digital, voice and data communications, space communications.

Advanced Equipment Design • solid state receivers, transmitters and repeaters, digital systems, digital data processing and display units, voice processing and reproduction equipment.

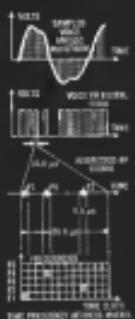
Familiarity with State-of-the-Art statistical theory of communications, spread-spectrum techniques, coding theory, integrated circuit applications, digital logic design, solid state electronic techniques, auto-correlation and cross correlation techniques.

We are particularly interested in programs on which your experience was obtained and the extent of your technical responsibility. Please address this information to our Manager of Engineering at the location of your choice for immediate and confidential attention.



MOTOROLA **Military Electronics Division**
An equal opportunity employer

©Motorola Inc., Phoenix, 1980 MILITARY ELECTRONICS DIVISION, Arizona, 85251 DAKAR, MALI, West Africa



[®]RAZEM (Radian Acousto-Digital Modulation) principle diagrammed above is the result of 5 years of independent Motorola research.

Machine That 'Learns' May Be Recon Aid

By Philip J. Klass

Folsom, Calif.—A machine which can quickly learn to recognize and identify complex patterns, suggesting its use for preliminary analysis of serial reconnaissance photos, was demonstrated here recently by Scope, Inc., MacLean, known as Conflict I (the "conflictless self"), was developed under contract to USAF's Avionics Laboratory.

Demonstration of Conflict I, a computerized electronic device which can identify a test set of which the classifier was shown two different front or postal profile photos of each of six different persons and in every case was able to correctly identify the person from the photo.

Air Force Program

Conflict I will remain at the Scope plant outside Washington for at least a year during which time it will be used for "some classified Air Force programs," according to company officials. This classified statement, coupled with the machine's unknown capabilities, suggests that it will be used in some military applications of serial reconnaissance photos obtained during the Cuban crisis to determine if it can be trained to recognize photos which show signs of a military strike.

Conflict I, developed and built over a 16-month period at a cost of \$200,000, is a Perceptron class of device but exhibits considerably more versatility than the Mark I Perceptron developed by

Convair Aerospace Laboratories (AW, July 4, 1960, p. 72). The current model Conflict has the memory capacity for learning to distinguish up to 16 different classes of patterns at one test, and for recognizing as many as 150 different variations within any single class.

For example, Conflict can be trained to recognize eight different characters, each of which would represent a "class" of patterns. Within each class, for example, the letter "A", the memory can be taught to distinguish up to 100 variations such as a capital "A", a lower case "a", a variety of different type faces and a variety of handwriting "A's", both capital and lower case.

In another demonstration of Conflict's capability, referred to as the "automatic post office test," the machine was caused to recognize the names of six states each beginning with "M," both when written in full and when abbreviated. Mississippi, Michigan, Minnesota, Maryland, Massachusetts and Missouri, Miss., Mich., Minn., Md., Mass. and Mo., were the names which the machine knew. When the machine was asked to name the state whose name was the same down-side-up, when the name was read for it in random order, it correctly identified the other seven in the remaining seven.

The basic elements used in the construction of Conflict I bear some functional resemblance to the Mark I Perceptron, yet differ in important ways (Refer to block diagram, p. 15). The elements of Conflict include the following:

- Sensory cells, or S-cells, are the means by which the machine is exposed to the patterns which it is trained to recognize and identify. Conflict I has 48 Perceptrons, one 400 phototubes in a 20 x 20 matrix. The output from each cell is an analog signal proportional to its illumination, providing half-tone (gray-scale) operation.

- Discrimination cells, or D-cells, total 5,000 in number in Conflict I, are randomly connected to the S-cells in a manner similar to that used in Perceptron between its "input units" and "association units". The magnitude of the output from each D-cell is determined by the presence or absence of illumination on the 100 S-cells in which it is connected.
- Memory cells, or M-cells, are a single input, single output device whose gain can be increased either in positive or negative test steps. In the Perceptron,

the memory function and the discrimination cell function are combined in the single discrimination unit. During the training period, one group of 5,000 memory cells (one cell for each discrimination cell) generates a statistical image of the patterns it must subsequently recognize, while each other group of 5,000 memory cells also quickly builds up a statistical image of the class of patterns which it must recognize. Thus Conflict I, with the capacity to recognize up to 46 different classes of patterns requires a total of 24,000 memory cells—5,000 x 46. Each cluster of 5,000 memory cells is assigned to remember a particular class of just four of the 46 possible classes.

Training Process

• Sensory inputs, or S-fields, of which there are 48 in Conflict I, each receive inputs from the 5,000 memory cells in its respective sensory field. The S-field generates an output signal which is the algebraic sum of its 5,000 input signals. After Conflict has been trained by accumulating a statistic image of each class of pattern in each sensory field, when it later is exposed to an unknown pattern which it has not already, the unknown pattern will produce the highest number of positive output signals from the memory cell field which it resembles most closely. Then the pattern recognition cell which generates the largest output indicates which of the 48 clusters corresponds most closely to the unknown pattern.

• Computer and examine the step-by-step class output signals from all 48 sensory units, determines which is the largest and indicates by means of lights which of the 48 classes corresponds most closely to the unknown pattern. In the Mark I Perceptron, the functions of the Conflict training unit and computer are combined in the Perceptron's "expander unit."

Conflict Differences

Despite the similarity of Conflict and Mark I Perceptron, there are important differences. Where the Perceptron was basically an analog machine, Conflict is basically digital. The statistical self-learning of the Mark I Perceptron, which consisted only 512 association units, was said to be mainly during the "absolute" training period for all classes of objects to be recognized. Conflict however, will associate memory units with a specific memory cell, the D-cell, of 5,000 memory cells for each class of pattern to be learned. Thus each memory field contains 5,000 cells in the class of patterns it must later recognize.

The distinguishing, or learning, function of the machine, during the absolute training period, is to train the memory cells to respond to a variety of different "A's". Next, a second sensory field will be trained to recognize "B", repeating the process described above. Thus the remaining memory fields will be trained, each to recognize a different letter of the alphabet.

allow the sensory cells to examine different portions of the pattern. For relatively simple types of patterns, the number can be reduced to as few as 30.

In actual operation, approximately 100 sensory cells located at random locations in the 400-cell field are integrated for roughly three microseconds. During that interval, the pattern or absence of illumination in front of each energized photocell is measured, processed by the discrimination unit and stored in the expander unit. Then the effect of each cell's influence on photocells is measured and the process is repeated. After 10,000 such integrations of the pattern (in a 10.5-second interval), a statistical image of one form of one class of patterns will have been stored in one of the 48 memory fields. Next it is necessary to train the machine to recognize varieties within this class of pattern. For example, if it is being trained to recognize upper-case letters, and it is being conditioned to recognize, for example, an "A", the "A" would be exposed in a variety of "A's"—upper and lower case, handwritten, bold writing, typed, and different printed type sizes.

To do this the class "A" memory field has generated a statistical image of a variety of different "A's". Next, a second sensory field will be trained to recognize "B", repeating the process described above. Thus the remaining memory fields will be trained, each to recognize a different letter of the alphabet.

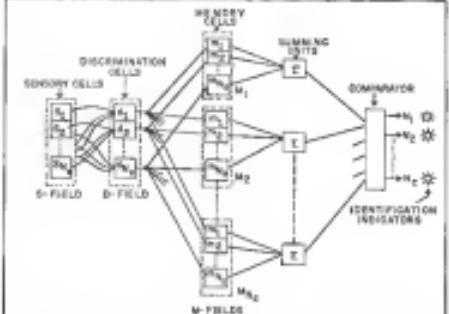
Or another from one to nine.

A more detailed examination of the operations of Conflict shows that the roughly 100 sensory cells whose outputs feed each discrimination cell are not needed so that half of them generate signals having opposite polarities from the other half. Then the signals from two discriminated cells will cancel each other if they have been wired into the machine with opposite polarities.

Solid Cells

If the patterns to which the sensory cell field is exposed at a solid color, whether white, red, or black, the equal number of opposite polarity signals from the individual discrimination cells will cancel out one another. Only when exposed to a non uniform pattern of illumination will there be a net signal developed, in that the signal represents the ratio of the dark to illuminated area being viewed by each group of 100 sensory cells during each discrimination cycle. Output of the discrimination cell will be one of two levels, a positive or negative binary level, at a rate depending upon whether the algebraic sum of input signals from its 100 sensory cells is positive, negative or zero.

During the Conflict training period, the first few thousand cycles of the discrimination cell signal is used to vary the gain of its associated memory cell. If the D-cell output is plus one, the gain of the memory cell is increased by one unit while if the output is minus one the gain is decreased by one unit. If the D-cell



AUTOMATIC PATTERN RECOGNITION machine, developed for Air Force, can be quickly trained to identify up to 40 different classes of patterns with up to 100 variations within each class. In experiment shown above, after machine had been trained to recognize six persons from their profiles, it can identify each from training photo as from similar persons it had never seen before.

BOOTS = RELIABILITY

A consistent program of testing, design refinement, and meticulous inspection makes reliability a built-in feature of all Boots products.

CAPPED LOCKNUTS PROTECT VITAL ASSEMBLIES



Boots capped locknuts guard against adverse effect of moisture from water, rain, protruding hot threads.

Boots capped locknuts keep metal-to-metal contact from finding exposed threads.

Boots capped locknuts increase the reliability of assemblies by guarding against the intrusion of insulation, damage from screws that are too long, galling of screw threads in high temperatures and corrosive atmosphere, as well as leakage from liquid storage tanks. All metal, one piece, self-locking, Boots nuts are simple in design, compact, lightweight and exceed government specifications for tensile strength. The A-265 stainless steel types have low magnetic permeability. Write for literature describing the wide range of regular and miniature types available.



160 KSI SERIES HI-TENSILE ANCHORS

The 160 KSI series provides high stress-rupture strengths, even at temperatures up to 500°F. In the aircraft industry, they are rapidly finding their application in the NAS series. For greater strength and dependability, chrome-molybdenum alloy steel (AMS 6564) is used, with nickel-cadmium diffusion plating. Despite added cost of material and finish, 160 KSI series nuts sell for two thirds less than steels of similar strength. For complete details send for the 160 KSI series catalog.



STANDARD AND MINIATURE ANCHOR NUTS

Boots standard and miniature anchor nuts are made to NAS dimensional specifications. They exceed military and industry standards for strength and operational temperatures. Available in stainless plated steel for 450°F application, and in chrome plated stainless steel for applications up to 200°F. For pressure vessels and ordnance applications are in the Boots Self-Locking Nut catalog, which will be sent upon your request.



BANG-LOC SELF LOCKING INSERTS

Boots Bang-Loc self-locking inserts provide dependable double-locking action in sheet metal, plastic and metal casting, wood and composition materials. The perfect fastener for joining plastic-coated halves of motor drives, hand tools, Bend for the Bang-Loc brochure to get the whole story.

BOOTS
AIRCRAFT NUT DIVISION
McGraw, Cincinnati

Townsend Company
ESTABLISHED 1814 • BEAVER FALLS, PA. • A **GENERAL** company

Aviation Products • Research, Development • Area 203 947-2400 • TWX 203 947-3463

Boots-Nutco • 403 North 3rd Street • Philadelphia, Penna. 19107 • Area 215 631-6515 • TWX 215 449-3481

In Canada: Farnham & Sons, Guelph, Ontario

output is zero, then the gain is not altered.

During the period in which the switches are being trained to identify, for example, alpha numeric characters and to recognize a variety of different forms of the letter "A," these memory cells whose discrimination and sensory cells are constantly exposed to a dark or white area for all varieties of the letter "A" will have their gain level increased repeatedly.

Alternates Exposure

But memory cells whose sensory cells are alternately exposed to dark and illuminated steps during the learning process will not undergo a significant increase in gain setting. This means that in later attempts to identify unknown alpha numeric characters, these memory cells with high gain settings will play a more dominant role in identification than will the hexagonal cells. However, all cells, regardless of gain, seem to discriminate between different classes of patterns, i.e., an "A" and a "B." The memory function is provided by a relatively slow electric charge pump with 100,000 volt capacity built by Laboratories for Electronics Inc.

The use of normal polarity sensory cells and a three-level output from the discrimination cells is intended to get around a problem which was experienced with the Mark I Perception, according to M. R. Ulphouse, one of the Conforfog project engineers. The ability of the Perception to identify different classes of patterns tended to be biased by the number of samples of each class it was exposed to during the training period.

Later Tendencies

For example, if it were exposed to train in class "A's" or "B's" during training, it exhibited a tendency to more easily identify some "B's" as "A's." In Conforfog, the use of the reversed polarity auxiliary signals tends to make the machine's response relatively independent of the number of different samples viewed during training, according to Ulphouse.

The number of discrimination cells required on Conforfog depends upon the number of different classes of patterns which the machine must be able to identify and the number of different variations within each class which it must recognize. Because Conforfog is designed to identify 10 classes with up to 100 variations within each class, the machine needs a minimum of 3,000 discrimination cells to achieve a high probability of successful operation. A total of 5,000 were built in to provide a worst-case surplus. If the numbers were reduced below 4,000, recognition odds would drop off sharply, according to

Edward C. Drane, another Conforfog project engineer.

The present machine has certain limitations which Soape, Inc., engineers at NASA are working to improve according to Drane. For example, any major rotation of the antenna at an azimuth position will result in the orientation position which the machine has learned to recognize, will cause identification difficulty if not impossible.

Under Air Force Department Contract 3000, Soape, Inc. is developing a pattern-recognition technique which is expected to make Conforfog sufficient to change its pattern position, angular rotation and/or size. The technique makes use of a series of pattern rows which is expected to extract information that is invariant, regardless of orientation, pattern position, rotation or size.

Conforfog was transferred recently and is contained in a desk-size console having a volume of about 25 cu ft. Drane says difficulties experienced that no alignment was made in the initial version to achieve maximum possible performance.

FILTER CENTER

► **Laser Communications Sought**—Development and fabrication of an inertial communication system capable of communicating over ranges up to 100 miles is intended to provide craft link with a 5-kc modulation bandwidth using a gallium arsenide 10-pm laser, as planned by NASA's Marshall Space Flight Center. Due date for the request for proposal is Sept. 6.

► **Solid-State Accelerometers**—Aerospace Instruments Laboratory will develop a solid-state force-sensing accelerometer with no moving parts under contract to be awarded by Bureau of Naval Weapons. Award is based on an unsolicited proposal.

► **Stressless Antennas Conference**—Giga-telegraph and stresswave considerations related to large membrane radio antennas are the subject of a conference to be held Sept. 14 at the Americana of New York. Sponsored by the Division of Engineering, New York Academy of Sciences, the meeting is limited to those invited to participate and to interested members of the academy.

► **Digital Space-qualification Index**—Curtiss-Wright, Division of Avco, New York, University scientists studying engine anomalies that could compromise propulsive line discontinuity and those with the best semiconductor characteristics induce current. One material currently under study, polycrystalline manganite, has induced current in rate to which it is melted. Interesting question is whether the current-carrying mechanism is the chemical or physical property of the

THE BULBED CHERRYLOCK® RIVET



SOLVES YOUR MOST DIFFICULT INSTALLATION PROBLEMS

Flesh Fracturing - Locked Spots

Reduced static load, eliminate expensive static freezing and minimize drive-in with the Bulbed Cherrylock® Rivet.

Seams as high as 340,000 have been reported due to stop "Pop-gauge Awards" for use of the Bulbed Cherrylock on wing skins and other missile applications.

This saving was accomplished by eliminating costly static freezing and reducing heat shrubbing to a minimum. Perfect heat shrinkable skins avoid most drive-outs.

Note the large bond areas across the blind hole. Bonding is important in thin sheet and double double rivulations.

Try the Bulbed Cherrylock on your most difficult applications — we can probably solve your problem.

For Technical Information on the Bulbed Cherrylock Rivet, write to Townsend Company, Cherry-Rivet Division, Box 2617N, Santa Ana, California.



Cherry Rivet Division
Santa Ana, Calif.

Townsend Company

ESTABLISHED 1814 • BEAVER FALLS, PA. • A **GENERAL** company

In Canada: Farnham & Sons, Guelph, Ontario



(From an ingénieur for certain sabotage becomes a Director Strategic Board and Dept.)

Source Selection Board (cont'd) I can see that this subsystem is highly desired ... but will we need some P&D spending to implement it?

TAPCO You'll be able to plug it in and start it.

SSB You sound pretty confident. What's your basis?

TAPCO There's no Black Eagle in it. Actually, there's nothing really new about the concept.

SSB You mean to say there's been no R&D?

TAPCO On the contrary. There's been plenty. In fact, there's been so much to us meet the contract. For example, we spend as much as twice money than anybody coming up with their staff.

SSB What are you driving at?

TAPCO Our guys have run up plenty of "I don't know" time over there, maybe. But the point is we're hardware oriented.

SSB Which means ... ?

TAPCO It means the men who put this system together are hard-nosed. They've

TRW/TAPCO, a division of
Thompson Ramo Wooldridge Inc.

BENRUS & ASSOCIATES • MANUFACTURERS OF AIRBORNE MISSILE LAUNCHERS, MISSILE STORES, AIRBORNE RADAR SYSTEMS, AIRBORNE POWER SYSTEMS, INSTRUMENTATION SYSTEMS, AIRBORNE CONTROL SYSTEMS, AND AIRBORNE FIRE CONTROL SYSTEMS

material. Work is being sponsored by Air Force Cambridge Research Laboratories.

► **RADC Plans Unconventional Computer**—Organizations having experience in innovative processing techniques using a computer-addendum, parallel-type tasks, to process are being sought by Rome Air Development Center for application to non-conventional computer operations. Request for studies is identified RAW-44-41?

► **Laser Beam Used for High Power Take-Off**—New application for lasers, which can open the way to high-power, representative lasers, has been developed by Cornell University researchers. In the technique, a pulsed laser beam is used to heat the tungsten cathode of a tube, providing current densities of 10,000 amperes per square centimeter, at least 100 times the current density available by conventional methods. Cornell's professor Leo Mandelstam predicts laser-heated cathode will permit design of high-power tubes operating at frequencies of 100-200 giga hertz.

► **USAF Test Division Conducts**—Initial guidance results for the X-20 has successfully completed 23 long duration unguided flights installed in a McDonnell F-101B. This will be followed by a high-speed-low-altitude sled test series starting this fall at the AF Missile Development Center, Holloman AFB, N. M. Series, both by Macmillan Atmospheric Dev., will be used to determine guidance position, attitude and speed during both orbital flight and re-entry.



Portable Transceiver

Personal portable radio Model SC-941, provides remote controlled AM transmission and receiver which can be operated "hands-free" for between aircraft communication. The 4-lb. set can be used on direct portable-to-portable links or operated through a control network and base station. Transmitter has 100-watt output over 40-94 mc band. Pulse location tone signal is available for emergency search purpose. Receiver is suitable for strong inter-commissioned linkups. Transistorized equipment operates for 20 hr from alkaline-manganese battery. Battery recharge is needed according to manufacturer, General Dynamics/Electronics, 1400 N. Goodman St., Rochester 1, N.Y.



Air Surveillance Radar Undergoes Evaluation Tests

New shipboard three-dimensional frequency scanning radar AN/FPS-40, built by GECItron for air surveillance, is shown aboard USS *Prittie* (DDG-51) during recent evaluation tests. Radar is used to provide information on airborne targets for Terrier missile or interceptor deployment. The FPS-40, which is Navy serially ordered in a quantity of 21 sets, is an upgrade of AN/FPS-32, tactical air defense radar developed by GECItron for the Marine Corps. To achieve small size, as well

as lightweight design, the company used 400 cps pulsed power supply and high-density packaging in combination with liquid cooling. GECItron uses a novel technique used for electronic scanning provides higher data rate and accuracy than is provided by more conventional approaches. Initial orders of FPS-40 systems will be used with Naval Tactical Data System (NTDS) equipped Fleet 1962 ELO shipbuilding program and to extend existing guided missile ships.



This one-page booklet contains printed and capabilities data from a leading manufacturer of airborne missile launchers, pods, landing aids, launcher power supplies, and related ground support equipment. It also features the use of a slingshot launcher. Please send an inquiry to company listed on back.

BENRUS

TECHNICAL PRODUCTS DIVISION
36 Cherry Avenue, Melville, Long Island, New York

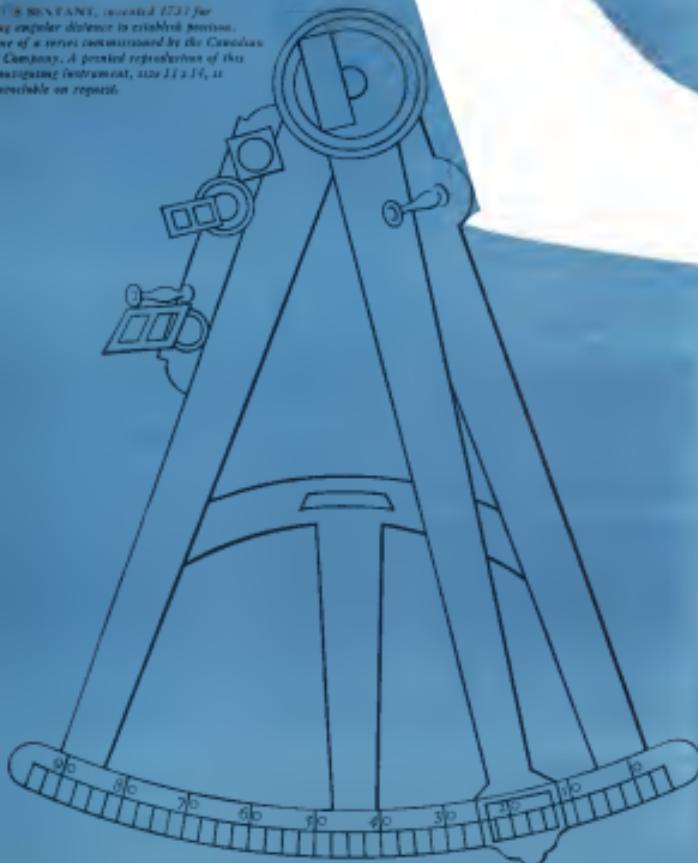
We hereby announce a new color film for instrumentation.

Officially it is rated at ASA 64—half the speed of Kodak Extachrome EIR Film—but it stands up far better to forced processing for unanticipated underexposure. (It can take 4 stops of underexposure, 2 of overexposure.) It is much finer grained. It can be run head-to-tail in processing machines with EIR. It comes in 16mm, 35mm, and 70mm. Arrangements to get it into your hands without delay can be worked out by Eastman Kodak Company, Photorecording Methods Division, Rochester 4, N.Y. (Phone 716 662-6090, Ext. 3257)

It is to be known as Kodak Extachrome MS Film

Kodak

HADE'S SQUANTINE, invented 1731 for measuring angular distance in celestial navigation. This is one of a series commissioned by the Canadian Marconi Company. A printed reproduction of this historic surveying instrument, size 11 x 14, is readily available on request.



232 years before DOPPLER

Between the sextant and Doppler lie 232 years of man's attempt to work an accurate track of his coming and going over the earth, and of his immediate position on the surface. Canadian Marconi Doppler provides a new measure to the navigator's art precision by the electronic for telltales, compass for direction, aid for position and chronometer for time. With the compass, CMC Doppler gives the art all three simultaneously, without human error, in the most accurate and reliable system used today. CMC designs and manufactures Doppler for "1" and "2" bands, Left/Right and Along and Cross Track Compensation, as well as indicators. CMC Doppler is applied to commercial transport, aerial survey, military transport, anti-submarine warfare, helicopters, V/S/TOL aircraft and supersonic aircraft.



CANADIAN MARCONI COMPANY
Canadian Marconi Division
545 YONGE STREET
MONTREAL 12, QUEBEC



Doppler Control Indicator

NEW AVIONIC PRODUCTS

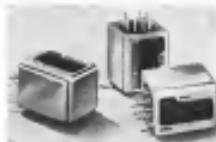
- **Ceramic miniature capacitors.** Types 36DC and 36MC, available for microwave type construction, have size corresponding to 1/4 watt and 1/4 watt composition resistor, respectively. Capacity ranges



+10% and -10% between mean temperature and -55°C or 55°C. Type 36DC is available with capacitance up to 0.01 pfd, while larger unit comes in sizes up to 0.03 pfd, in ratings up to 100 v dc. Manufacturer: Sprague Electric Co., 235 Marshall St., North Adams, Mass.

• **Step-down spectrum analyzers,** which can reduce bandwidth requirements by as much as 1,000:1 for narrow band FDM, PCM or PDM telecasts, use square-wave frequency detector to extend dynamic range. Model OS-1K covers 75 to 1,000 cps., Model OS-1R covers 100 to 10,000 cps. Analyses weigh less than 21 lb., consume 140 watts at 28.4 v. Manufacturer: Caladan Industries, Inc., 212 Durban Ave., Metuchen, N.J.

- **Stable a.c. voltage amplifier,** Model 151-A, which exhibits stable gain over operating temperatures of -65°F to



230°F, is designed to withstand rigors of aerospace environment. Device, mounted in molded plastic container, weighs less than 13 ozs. Bulletin F-6310-4 gives application data. Manufacturer: Tube Instrument Corp., 157 Conduit St., North Tonawanda, N.Y.

• **High-power RF transistor,** Type 2N-287, delivers 10 watts of RF power at 100-mc frequency, with collector efficiency of at least 50%, from a 45v power source and has an isolated collector. Device is housed in a double-sided power package. Manufacturer:

TRW Electronics/Pacific Sciences Div., Inc., 14100 Aviation Blvd., Los Angeles, Calif.

• **Digital seismograph plotter,** Model 10051, records seismographs from an IBM 7090 computer, translates it into graphic plot with annotation and line plotting. Device permits group viewing



of quick-look data on a nearly real-time basis. The high-speed recording plotter, consisting of diskette, counter, printer and 100 pounds per inch dry copy, plots 100 cps. operates at 100 kc, and can accept, decode and mark a maximum of 100 ten-bit words per microsecond, not counting computer cycle time. Manufacturer: Bendix Dynamics Corp., Hanover, Pa.

• **Gas-driven miniature potentiometer,** Series T-1121, measuring 0.5 in. in diameter, has adjustment wires along the edge permitting up to 40 units to be stacked in volume of one cubic inch



The trimmer pot is available in resistances of 50 to 70,000 ohms with resolution down to 0.16%. Device operates over temperature range of -55°C to 175°C and is rated at 1 v at 40°C. Weight is 1.1 gm. Manufacturer: Astro Electronics Inc., 312 E. Lake Club, Arcadia, Calif.

• **Super-Power Microstrip Tube,** reportedly the most powerful continuous-wave tube ever built, generates 455 kw at 3,000 mc (X-band) with efficiency of 75%. The 6-ft-long superpower Amplitude weighs 480 lb. Manufacturer: Raytheon Co., Waltham and Everett, Mass.; Waltham 24, Mass.

Remember the DC-1?

FIRST OF THE DOUGLAS AIRLINES ...



Graph Alvin D'Orsay, Inc. Photo

...and Barber-Colman was there!

Remember the early '30s? The forerunners of modern transports were just taking off then. In 1932, Douglas Company flew their first airplane, the twin-engine 12-passenger DC-1... quickly followed with the 14-passenger DC-2 in 1934.

The 21-passenger Douglas DC-3, introduced in 1935, proved itself so rapidly that it was carrying the bulk of American domestic air traffic by 1938. Most famous and successful aircraft in history, the DC-3 had a cruising speed of 180 mph, and a range of 1,000 miles. Among many innovations that gave these first aircraft definite commercial advantages were wing flaps, multi-spar wing construction, and a Barber-Colman thermostat to help control cabin temperature.

Eventually, the DC-3 flew far virtually every nation and airline, before serving as the C-45 work-

horse of World War II. Some 8,025 of this aircraft and its derivatives had been built when production ended in 1945.

Like Douglas, we've kept refining our products since 1893. Learn to anticipate the critical performance you expect from actuators, air valves, and temperature control systems. Call the Barber-Colman representative near you, or drop us direct—Area Code #159/948-6813.

Todays Barber-Colman products are here:

John H. Bradford Queen Air
North American A.M.
Boeing KC-135
Lockheed P-3V
Saturn Vehicle

... plus many other modern aircraft, rockets, and missiles.

"Observe cautiously that all things take place by chance."

—MARCUS AVERILL

BARBER-COLMAN COMPANY
Dept. T, 3402 Rock Street, Rockford, Illinois



AIRCRAFT AND MISSILE PRODUCTS: Air Valve, Electromechanical Actuator, Temperature Control Systems, Pressure Control Systems, Thermometers, Special Ground Test Equipment, POLYFORM Electromagnetic Shielding

Ideas on space propulsion



DIBORANE · TRIETHYLBORANE · HYDRAZINE BIS-BORANE
DECABORANE · PENTABORANE · NITRYL PERCHLORATE

Check the superior performance of these materials in your space-storable and earth-storable propulsion systems. Ask Gallery for price quotations and delivery schedules on any amount from a pound to tons of liquid and solid boranes or nitryl perchlorate solid oxidizer. Gallery Chemical Company, Defense Products Department, Gallery, Pennsylvania. Telephone: Evans City (Pa.) 3520. Other offices in Sherman Oaks, California; and Washington, D.C.



FREE WORLD'S ONLY BORANE AND NITRYL PERCHLORATE SUPPLIER

PRODUCTION BRIEFING

Who has some very good California openings?

Amplex

If you qualify, you'll find it rewarding to work at Amplex.

ROCKWELL SPACE CRAFT DESIGNER. Must have a BSCE, two to six years experience in in-orbit maneuvering, rates,姿控 and pulse control designs, and knowledge of transversal power systems. Also must be experienced in closed-loop control servos.

ELECTRICAL/MECHANICAL DEVELOPMENT ENGINEER.

Must have a BSCE or advanced diploma. Two to six years experience in electrical/mechanical design, modeling on techniques, telemetry, data storage handling and digital recording systems.

DEVELOPMENT ENGINEER. Must have a degree in electrical engineering, plus an interest in physics. Must be experienced in the design, development and evaluation of new high speed servo mechanisms and control devices, electro-mechanical servos, and other related areas, as well as advanced closed loops for feedback acquisition and control electronics.

CRYSTAL OSCILLATOR ENGINEER. Must have a degree in electrical engineering and have experience in crystal design and aging analysis. Must have experience in speed control, crystal frequency stability, or control circuitry for high performance, series resonance, low harmonic oscillators.

MICROMECHANICAL ENGINEER. Must have BSME or relevant degree. Two to five years experience in analog or electro-mechanical instrumentation. Must have experience for developing or testing micro-mechanical rotating mechanisms, two to three microprocessor reading instruments, test of micro-mechanical components, and design for sophisticated tape transports.

PURCHASER. Must have PhD in optics and up to 10 years' experience leading Phase I and experimental studies at Wright-Patterson Air Force Base. Must have strong AF-1 Fire protection, solid state materials or electronic optics.

At Amplex, you'll live in the San Francisco Bay Area or the Los Angeles area. You'll work with the brightest minds in the industry. You'll be part of a company trying to make all of its multi-million dollar development programs a complete success. And you'll be part of a company that's one of the world leaders in analytical recording technology—from ultraviolet recording to terahertz—and everything in between.

For prompt action
send a letter of application to
Mr. Charles A. Moulton,
Office of Executive Placement,
Amplex Corporation, 401 Broadway,
Redwood City, California.
An equal opportunity employer.



AMPEX



What new data recorder can be simple—or sophisticated? **AMPEX FR-1200**

Here's the newest recorder from Amplex—the FR-1200. It's a medium priced, basic data recorder that's modular in design and built for long-term reliable operation. With the FR-1200, you'll often encounter types of electronics and software that you may never have seen before. Whether it's simple or as sophisticated as you want—such as that meets your needs and budget now, and can be expanded as you grow. You can start at the simplest level—a one-speed speed reel-only recorder—and build all the way to a 34-track, record/reproduce system with sam-



AMPEX

speed (1 ips to 60 ips) electrically switchable electronics and transport. Amplex ES 300 solid state electronics offer direct recording to 300 KHz, or recording to 20 KHz, or 100 compatible FID. The FR-1200 also features a solid state transport. Reel-to-reel tape offers fast starts, provides constant tape tension on both reels and has new tape braking and guidance systems. For details write Amplex Corporation, Redwood City, California. Sales and service engineers throughout the world



SILENTBLOC DYNAMIC between Shims (1) and Housing (2) induced by wheel vibration causes viscous damping which is proportional to velocity and force effective damping of containing wheel during an impact response range of -10 degrees to +10 degrees F.

UNLIMITED angular rotation allows 360 degrees about 'F' axis.

UNIQUE wing mount configuration ideal for aircraft vibration control applications.

DATA is recorded on magnetic tape for voice with minimum maintenance. No valves or external on-board instrumentation.

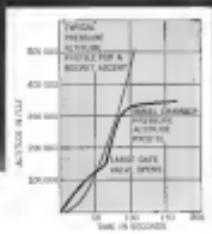
WHEN YOU NEED Analytical or automatic recordings produced from systems or any other electronic source, Amplex can provide the appropriate flexible delivery. Houdaille's basic idea is to produce, in part or whole, a special problem fit.

Houdaille Industries, Inc. SURGICAL HYDRAULICS DIVISION

Dept. AW 201 East Harrison Avenue, Bellmawr, NJ 08031
Telephone 800-462-4663 Telex 64-746244

HOUDAILLE
INDUSTRIES, INC.
SURGICAL HYDRAULICS DIVISION

Dept. AW 201 East Harrison Avenue, Bellmawr, NJ 08031
Telephone 800-462-4663 Telex 64-746244



EIGEN-TO-ALTITUDE TEST FACILITY: There is a 4 ft. dia. closed-loop cylinder 10 ft. long. The cylinder has been designed and fabricated to simulate the pressure history experienced by a nuclear weapon positioned at its intended altitude. The large diameter allows a maximum pressure gradient of 10% over the entire length of the cylinder. The cylinder is supported by a fixed base and has a fixed orientation of 45° from the horizontal. The cylinder is sealed at the top and has a large pressure vent valve located near the bottom.

INSTANT SPACE SIMULATION (JUST ADD VACUUM). The nose-to-altitude chamber, to simulate pressure changes encountered by rocket-borne payloads, is a new addition to the Bendix environmental laboratories where engineers design, fabricate and test space vehicles. Engineers experienced in integration, assembly and test will find new careers at the Bendix Systems Division, Ann Arbor, Michigan. Write or call our Personnel Director.—An equal opportunity employer.

Bendix Systems Division



WHERE IDEAS
UNLOCK
THE FUTURE

lot space. The building will house the 600 acre synchrotron which will be the heart of the facility. Construction calls for completion within 600 days from Aug. 19.

Air Force Logistics Command, Wright-Patterson AFB, Ohio, will serve-test a new procedure for storing and maintaining cargoaving drawings with Lockheed's C-141B jet cargo transport. New procedures calls for the press not exceeding 100 psi when storing or moving drawings on Air Force weapon systems as they are developed and enter the operational force. The drawings will be stored in a separate compartment in the C-141A when they are needed. If successful, contractor will no longer have to furnish the Air Force with complete sets of drawings.

Douglas Aircraft Co.'s Aerospace Div., Santa Monica, Calif., has been awarded two Air Force contracts totaling \$661,300 for production of TDU-10B tow targets. The targets are used for anti-aircraft gunnery practice.

Liquidated California Co., Inc., will do a preliminary design study under a \$750,000 NASA contract of reusable rocket aircraft concepts for transporting passengers and cargo to and from orbiting space stations. Study would consider 10 passenger capsules that could be in operation by 1973-74. Major objective of the study is to attain a passenger safety level comparable to present conventional aircraft.

Dear Siegler, Inc., Grand Rapids,
Mich., has broken ground for a \$1.3-million administration building for its
Instrument Div. Building is scheduled
for occupancy in June, 1964.

Brown Instrument Div. of Honeywell has been called the Philadelphia Div. of Honeywell's Industrial Product Group in line with a new corporate policy of naming Industrial Product Group divisions after their geographic location. The group's P&E Div., Mass., health care will be transformed and added to the Philadelphia Div. by the end of 1993.

Ryan Aeronautical Co., San Diego will study the feasibility of developing warning systems for use against nuclear weapons under an Army Material Command contract. Associated with Ryan on the project are Arthur D. Little, Inc., Aerodata Div. of North American Aviation, Meteorological Research, Inc., and the Military Products Div. of Hallatron Electronics, Inc.

Port & Whitney Aircraft, East Hartford, Conn., has sold a second "Turbojet Power Pac" to the Delaware Power & Light Co. in Wilmington, Del., for

during periods of peak demand and The unit, powered by a much larger gas turbine, is rated at 17,000 kW for intermediate use. The unit is fueled and uses natural gas for fuel.

Dynamac Corp., Cleveland, has received a \$4-million order from Lockheed Georgia for additional long-haul trucks for the C-141 Starlifter medium jet transport. Each unit has 16 such trucks in eight configurations.

proposals are due Sept. 17 on a contract to supply liquid hydrogen to Marshall Space Flight Center and Manned Space Test Operations. National Aeronautics and Space Administration has estimated that the two facilities will require approximately 75-8 million lb of liquid hydrogen during the base period 1965-70.

The *RIG* for *MIC*

**MILLERMATIC
WELDING
GIVES YOU
TEN BIG
ADVANTAGES**



Thin gauge metal or heavy sections - there's a MILLER-ATTC MAG combination to handle your job better.

1. High current capacity
 2. High speed
 3. Deep penetration
 4. Minimum heat-affected zone
 5. Minimum distortion
 6. Effective metal transfer
 7. No flux — no cleaning
 8. Operation from single- or three-phase service
 9. "In the field" operation — away from power lines (with Miller engine-driven equipment)
 10. Easy to operate

Supply upon request.

miller ELECTRIC MANUFACTURING COMPANY, APPLEVILLE, WISCONSIN
107-0702-3 Red 10th Street, New York 10-4711 - Broadcast in French by Canadian radio on C.B. 121, Toronto

Mitsubishi Seeking U.S. Sales Penetration

Kerrville, Tex.—Detailed planning by Mitsubishi Heavy Industries, geared to breaking into the U.S. business aircraft market in a major competitive, is the keynote of its agreement with Mooney Aircraft, Inc., to assemble, sell and service the Japanese firm's new MU-2 turboprop-powered executive transport in this country. Canada is also mentioned as a potential market.

Nature of the Mitsubishi-Mooney pact underscores the serious effort by the diversified Japanese industrial giant—which had international sales of about \$1.2 billion last year—to extend its air transport overseas and to penetrate the business aircraft market.

The more hostile a new competitor factor that may be facing the U.S. business aircraft industry within the near future.

The significant aspects of the agreement were emphasized by Mooney executives here.

■ **Mitsubishi** initiated conversations with Mooney leading to the pact, over time were not made by the American firm. Mooney executives say that they were both surprised by Mitsubishi's request to negotiate and expressed by the management of the Japanese firm apparently had made of the U.S. company's products and standards. "They know about as much about us as we do," commented Mooney President Hal Rechel and Vice President Manufacturing and Engineering, Ralph

Hanson. "They had a dinner that night, including what appeared to be every article on anything we wanted about us, and numerous pages of head news items in Japan."

■ **Mitsubishi** spokesman emphasized that the MU-2 had been specifically designed with the United States in mind as the No. 1 market with the idea of putting major emphasis on sales in the country. For this reason, the Japanese are engaged to meet U.S. Federal Aviation Agency requirements under Part 21.

Also, the production model is to be sold to the American market initially, but for the highest percentage of U.S. designed and built parts and equipment ever incorporated is an aim to be introduced into their country, Mooney executives said.

According to Mooney officials, these factors were considered by Mitsubishi in the Japanese firm's evaluation of a U.S. partner in the MU-2 program.

■ **Mitsubishi** sought an aircraft company which did not have a competitor in the MU-2 and might be interested in adding that type of plane to its sales line.

■ Mitsubishi wanted a company with a good growth pattern. Mooney recalled that in early 1963, 20 years ago, 1973 has a volume of about \$400,000. This rose to approximately \$5.5 million last year on deliveries of about 345 units. The Texas firm's expansion program

calls for doubling its present production area of 553,000 sq ft. In adding a 105,000 sq ft facility to its operation at Kerrville Field here.

Mooney's interest in the program stems from its long-range plan to add a multi-engine turboprop-powered executive aircraft to its line in the future. This plan had envisioned a twin turboprop to be planned by 1970.

Mooney's management believes that with the development, engineering and test costs being handled by Mitsubishi, the MU-2 provides an economical way to get into the field earlier although R&D costs are higher. The addition of the Japanese aircraft does not mean that the turboprop-powered airplane program will be scrapped. Mooney's product expansion policies call for seven aircraft models, including a piston-powered light racer and the MU-2 is the base in 1973.

Significant concessions Mitsubishi made in its agreement with Mooney include the right for the Kerrville company to act as its marketing agent in the country for the American-made equipment and parts that Mitsubishi will install in all production aircraft.

In the case of inclusions delivered to Kerrville, Mooney says in this hemisphere, the Japanese manufacturer will license to Mooney the rights to sell in the Americas to assist the Japanese firm better compete in the market.



Jet Commander Speed Brake Installation Shown

First photo shows speed brake installation atop wings of new Commander's Jet Commander prototype. Brake arm itself of leading edge to close circuit for tailotta position. Speed brakes are about 55 sq ft in area and are designed to be used at all speeds up to structural limit cruise of Mach .80. Company facilities are 25% occupied with Jet Commander production (see below).

Mooney would install fuel cells, pumps and other equipment.

It study shows that certain MU-2 components—that would be necessarily made in Japan—can be built in the U.S. more economically than their counterparts in Kerrville, this procedure might be adopted, according to Mooney.

Mitsubishi agreed that the MU-2 would be marketed under the Mooney name. This name would be followed by a revised representing the Japanese company, the designation MU-2.

Mooney indicated that the market potential for the MU-2 might be about 100 aircraft in 1965, while the first aircraft will be available for delivery to U.S. customers, and possibly 40 to 60 the following year. Mooney declines to estimate volume after that period. It is estimating delivery of a demonstrator to Kerrville in late 1964.

Although plans are already under way for programming a certain sale area in its new plant to accommodate MU-2 assembly, Mooney feels it has approximately a year or 15 months to develop a production plant in Kerrville.

Sales details will be made available to its distributor dealer organization during the annual factory meeting in mid-October. But Mooney probably will authorize the taking of orders with deposit fees full for 1965 delivery. The price would be set at about \$700,000 for the basic version, with a standard interior and instrument flight rules (IFR) instrumentation and navigation



Wing of first production Jet Commander takes shape in assembly jig at firm's Kerrville, Okla., facility. One poor recently was placed at 300 ft over for leading Steinbeis tail which ends with portions containing integral fuel tanks.

communications installations, not including radios or intercoms.

Optional electronic equipment loans to Mooney's 100+ adaptive type.

Some changes in the program may develop, based on the firm's announcement that it is now taking orders.

The King Air appears to be the major competitor to the MU-2 on the basis of early deliveries (fall of 1964), being a larger airplane, and with a price tag set at approximately \$700,000 versus



Beech Plans 1964 Delivery of King Air Turboprop Transport

Retouched photo of converted Beech Queen Air shows configuration of the company's proposed new Model 90 King Air 65-passenger transport (AVW Aug. 18, p. 29), which Beech plans to fall 1964 delivery. King Air will be powered by two 1,500-shp Canadian Pratt & Whitney PT6s. Construction of first Model 90 is under way. Price, same as currently is about \$800,000.



SOLID PROPELLANT PRODUCTION FACILITY-U.S. AIR FORCE PLANT 458: Lummus architec/engineering design for the propellant complex included auxiliary facilities for MINGUTZMAN horizontal impinge mixing, propellant handling and storage canisters, and rocket-engine handling.



LUMMUS ENVIRONMENTAL RESEARCH FACILITY-U.S. ARMY CORPS OF ENGINEERS: Lummus performed the conceptual engineering for the simulator which established the environmental test facility for the Army's F/A-18 Hornet. Temperature range is from -62°F to 141°F; force range is from 0 to 12.0 g's; vibration range is 0.01 to 10.0 Hz; and solar radiation from the intensity of the noonday sun up to 12.0 kw/m²/sq ft.



WORLD'S LARGEST LIQUID HYDROGEN PRODUCTION FACILITY-U.S. AIR FORCE PLANT 458: Lummus designed, engineered, and constructed the hydrogen production process plants of this plant to produce 99.9% pure hydrogen, which is then liquefied through cryogenic processes.

PROCESS ENGINEERING MODEL, U.S. NAVY PROPELLANT PLANT, NITROPLASTICIZER UNIT: In addition to process design for hydroplasticizer units, Lummus performed design functions for conversion of the art less batch to continuous process, for a planned existing plant to produce intermediates for possible fuel application, and for attendant instrumentation/measurement facilities.



Lummus serves the Aerospace Industry

From technical feasibility studies to detailed architect/engineering and construction services, The Lummus Company serves the aerospace industry with a high degree of professional competence. Lummus' vast experience in the architect/engineering and construction of nearly 1,000 major industrial and process plants for industry and Government throughout the world has

created a staff knowledgeable in cryogenics, metallurgy, liquid and solid propellants, nucleonics, chemicals, physics, radiation physics, high vacuum technology, and solar simulation.

For creative engineering, skillful project management, and on-time construction—consult Lummus.



THE LUMMUS COMPANY

505 Madison Avenue, New York, NY 10022
Government Operations Division, 1001 Connecticut Avenue, Washington, D. C. Offices and Suboffices: Bethesda, Maryland; Montreal, Quebec; Paris; The Hague, Madrid; Mexico City; Tokyo; Engineering Development Center, Newark.

ARCHITECT / ENGINEERS AND CONSTRUCTORS FOR INDUSTRY AND GOVERNMENT





*The
New Look*



EXECUTIVE AIRCRAFT

HFB 320 HANSA

7.12 Passengers — 2 PW60 — 1,083 st. mi. range — 410 kts Cruising Speed — Thrust Reverser
Low Pressure Tires for Unprepared Airfields — 2 x General Electric CJ-630-1

HAMBURGER FLUGZEUGWERK GMBH Herings/Paderborn Germany

electronics. Neither Mitsubishi nor Mooney aircraft was aware that Beech would convert the King Air program at such a fast pace (AW Aug. 18, p. 29).

Many of Mooney's goals from '81 sales outlets are not developed to handle the market for the larger turboprop MU-2. Mooney probably will need additional distribution with facilities capable of servicing the airplane.

Promotion of Mitsubishi's Nagoya Air craft Works, which designed the MU-2, showed considerable willingness to incorporate Mooney design input into the airplane during negotiations.

These included suggestions for stretching the airplane's range by retrofitting of 30 gal. wingtip tanks.

Even more important was acceptance of the Kurella manufacturer's most basic that the airplane be fitted with either the PW60 or the Arleswick 551 turboprop engine to ensure that the company would not be dependent for their prepayments upon engine supplier.

Mooney leans toward the Arleswick 551—although the canards would force an option on choice of the two propulsors because of the lower price (about \$6,000) and because Mooney engineers think the 551 is a simpler powerplant. Propulsion would be three-blade Har-

leymann. Neither Mitsubishi nor Mooney aircraft was aware that Beech would convert the King Air program at such a fast pace (AW Aug. 18, p. 29).

Many of Mooney's goals from '81 sales outlets are not developed to handle the market for the larger turboprop MU-2. Mooney probably will need additional distribution with facilities capable of servicing the airplane.

Promotion of Mitsubishi's Nagoya Air craft Works, which designed the MU-2, showed considerable willingness to incorporate Mooney design input into the airplane during negotiations.

These included suggestions for stretching the airplane's range by retrofitting of 30 gal. wingtip tanks.

Even more important was acceptance of the Kurella manufacturer's most basic that the airplane be fitted with either the PW60 or the Arleswick 551 turboprop engine to ensure that the company would not be dependent for their prepayments upon engine supplier.

Mooney leans toward the Arleswick 551—although the canards would force an option on choice of the two propulsors because of the lower price (about \$6,000) and because Mooney engineers think the 551 is a simpler powerplant. Propulsion would be three-blade Har-

Mitsubishi MU-2 Specifications¹

*Powerplants:	2 Turboprops	1,210 ft Astro 260 or 182 ship taken, 400 rpm maximum continuous rev. avg.
Maximum cruise speed at 20,000 ft	200 kph	1,210 ft 315 mph
Maximum cruise speed at 60% power	200 kph	6,390 ft 315 mph gross weight
Maximum cruise speed at 70% power	200 kph	7,140 ft gross weight
Rate of climb at sea level, two engs	2,100 ft/min	1,090 ft gross weight
Rate of climb at sea level, single en gine	630 ft/min	3,110 ft gross weight
Service ceiling, two engines	18,000 ft	3,760 m gross weight
Servicing ceiling, single engine	19,000 ft	3,720 m gross weight
Stall speed, flaps down	63 mph	5,940 ft gross weight
Takeoff distance, at level, sea level, over 50 ft. obstacle	113 mph	1,000 ft gross weight
Takeoff distance, at level, sea level, over 50 ft. obstacle	7,940 ft	1,210 ft gross weight
Takeoff ground run, at level, sea level, over 50 ft. obstacle	7,940 ft	1,210 ft gross weight
Takeoff ground run, at level, sea wind, 7.940 ft gross weight	740 ft	1,210 ft gross weight
Landing distance, at level, sea level, over 50 ft. obstacle	6,890 ft	gross weight
Standard gross weight ²	7,220 lb	
Minimum gross weight ³	7,940 lb	
Usable fuel capacity, standard intensity top tank	198 lb/180 gal	
Span	35 ft 9.5 in	
Length	32 ft 2.6 in	
Height	12 ft 5.8 in	
Wing area	107.9 sq ft	
Cabin length	31 in	
Cabin width	4 ft 11 in	
Cabin height	4 ft 12 in	
"Memory plane" installation of PAFW		
PT-6A or Arleswick 551 turboprops		
Performance is estimated, prior to flight		
Mean life tanks		
With life tanks installed		

booster free world defenses...

...while helping man utilize the sea and explore the unknown

From those uncharted places in the vast expanse of the sea, a missile is launched—it races through the ocean depths, bursts into the atmosphere, and homes in on a threatening enemy target over a thousand miles away...a target that must not be missed! To help meet that challenge, Interstate Electronics Corporation provides the instant real-time intelligence that assures all systems are "Go" on every new Polaris submarine launched by the U.S. Navy.

DURING THE PAST DECADE, IEC HAS PROVEN ITS EXCELLENCE IN A NUMBER OF CRITICAL AREAS:

- 1 INSTRUMENTATION DATA SYSTEMS
- 2 DATA ACQUISITION CONVERSION PROCESSING AND RECORDING
- 3 PHASE LOGIC INSTRUMENTS AND TECHNIQUES
- 4 REMOTE SYSTEM TEST EVALUATION
- 5 SHIPBOARD SUPPORT AND CHECKOUT SYSTEMS
- 6 TELEMETRY SYSTEMS
- 7 MOBILE INSTRUMENTATION EQUIPMENT
- 8 SAT FREQUENCY/TIME SYSTEMS
- 9 FUNCTIONAL ELECTRONIC PACKAGING
- 10 GEODESIC/GEOPHYSICAL INSTRUMENTATION SYSTEMS
- 11 MARINE PHYSICS AND HYDRODYNAMICS
- 12 COSMIC ENGINEERING, METEOROLOGY, AND MARINE FORECASTING

To meet the challenges that lie ahead, IEC scientists and engineers continue their code of ethics, committed to maintaining military and professional independence.

For a complete brochure on IEC capabilities and accomplishments write to your representative, addressed to P.O. Box 102.



UTILIZING THE SEAS

An important division of Interstate Electronics Corporation is an organization of eminent atmospheric and scientific know-how. National Marine Consultants, in addition to their coastal barriers to the development of electronic instrumentation for military and civilian marine applications—these NMC specialists are continuously advancing the state-of-the-aerospace science to help man in his quest for a better life. Typical areas of competence include (1) marine physics, (2) oceanographic and AEW instrumentation, (3) structural analysis and design, (4) hydro design and layout, (5) shoreline protection, (6) field surveys and (7) mine and waste disposal researches.

For more information, write Dr. R. E. Karl, P. O. Box 807.

NATIONAL MARINE CONSULTANTS

A Division of



INTERSTATE
ELECTRONICS CORPORATION
MANUFACTURERS & IMPORTERS OF
INSTRUMENTATION

Pyonet 600	Type 400-C	320	1000	V-S-M	N-100	Wesley
A-250						
H-46	V-57	12-400				
No. 400						
Lapley						
AMS 590	M-250					



How do you build an astronaut?

Take dedication, guts, intelligence...blend them smoothly into a pioneering spirit and determination, plus a whopping measure of confidence in the magic carpet he rides. That's how you make an astronaut. Much of the confidence comes from Carpenter High Temperature Alloys, produced in the many grades listed above. Fabricators, forge shape, cold headers, and prime contractors for space projects rely on product quality, technical service, personal assistance and dependable delivery from Carpenter. If you're engaged in an industry that's helping to build astronauts, or any project involving elevated temperatures or stresses, Carpenter offers you help and confidence. As a start... send today for your copy of this convenient High Temperature Alloy Slide Chart. It's filled with fast, easy-to-use data on analyses and properties. The Carpenter Steel Company, 120 W. Bern Street, Reading, Pa., 19603.



Carpenter steel

HIGH TEMPERATURE ALLOYS • TOOL AND DIE STEELS • STAINLESS STEELS • ELECTRONIC, MAGNETIC AND SUPERCONDUCTING ALLOYS • SPECIAL-PURPOSE STEELS • TUBING AND PIPE • FINE WIRE SPECIALISTS

and all U.S. production MU-2s would have the Astarion powerplants. The Turbomeca Astazou would be retained on those sold by Mitsubishi, at least on one MU-2s far safer to the Japanese government.

Although a contract has not been signed, the Japanese Self Defense Force probably will buy some MU-2s, pending outcome of the flight test program. First flight of MU-2 prototype, powered by Allison, is scheduled for this month.

The MU-2 is an extremely compact aircraft (AW, Apr. 1, p. 38), roughly comparable in size to the Piper Aztec. Wingspan of the aircraft actually is slightly less than that of the Mooney, Model 21A, 35 ft.

Construction is conventional, with straightforward aluminum alloy fabrica-
tions riveted throughout. Wing is one piece and employe dihedral, double-skinled flaps, with about 25% glaze-
and a spider system for lateral control.
The long flap, together with the
airplane's elongated, pointed fuselage,
the gearless nosewheel, and the high
wing position to elevate adverse torque
effects from the rudder.

Fuselage is circular configuration
with a 50.5-in.-diameter outside
diameter; providing for two-place, side-
by-side crew seating and two foldable
seats and a three-place down in the
standard cabin configuration.

Cockpit and cabin pressurization will
provide for an equivalent 8,000 ft altitude
while the plane is at 20,000 ft. Cabin entrance is through a door on the
left side of the fuselage. A 25.05-cu-
ft baggage compartment is located aft
of the cabin, just behind and above the
main landing gear, which retracts into
the lower fuselage.

Japanese Survey

Top—Representatives of nine Japan-
ese companies engaged in space pro-
grams as experts will participate in
Japan's first satellite survey mission, which
will take measures on Southern Asia and Australia over a period of about 31 months. The mission is reported to
have Japan at the end of October.

Organized by the Ministry of Japanese
Aerospace, the mission will use a space
survey satellite made by Japanese
built strength, such as the YS-II meteor-
ite-pump transport and the MU-2 executive
aircraft, as well as parts and engines.

The mission, to be led by Yukio Ye-
shiba, adviser of the Big Blue Indus-
trial Co., will be made up of representa-
tives of the nine Mitsubishi Heavy In-
dustry Co., Japan Aircraft Manufac-
turing Co., Kawasaki Aircraft Co., Ihi
Kippis-Hanwa Heavy Industries, C.
Ishii & Co., Nippon Crayon Mfg. Co.,
Cv and Mitsubishi Co.

SANDWICH AT KITTY HAWK

What would that bird have looked like back in 1903 had Orville and Wilbur been able to use sandwich panel surface power of engine heat? The point is that early aircraft sandwich panels were developed. Relying on the experience of the aircraft industry, Hexcel has developed a new design for sandwich structures that make honeycomb sandwich construction a practical design alternative for today's applications.

TAKE LARGE SHELL STRUCTURES

Why Honeycomb Technology?
Extremely high strength-to-weight ratio. • Structurally self contained.
• Self sealing.

An interesting new report is available on Design of Large Structural
Optimizer Structures. WHM is the Engineering Paper of 1983.

Large structures can be made more competitive by:
• Utilizing a large number of smaller components. • Shorter lead time. • Dependable delivery.

Supported by the largest R&D staff and expandable applications engineering groups of all honeycomb manufacturers.



HEXCEL PRODUCTS INC.
Executive Offices: 1100 South St., Reading, PA 19601
Sales Offices: Atlanta, Ga.; Boston, Mass.; Chicago, Ill.; Denver, Colo.; Houston, Tex.; Irving, Tex.; Kansas City, Mo.; Seattle, Wash.



ROPER PUMPS for aircraft

Roper four-blade pump can be used for systems requiring many small, unidirectional flows. The pump is designed to operate in a one-line. The type of pump requires that certain directions flow with respect to a central axis. This allows each pump to give each pump station independent operation. The pump's stainless steel construction is designed to withstand severe operating conditions. There are only two mounting points for simplicity and freedom of design.

Uniblock 600 pump can be used for systems requiring bidirectional, straight or 90° flow in any direction.

For complete details, write today. Your inquiries will receive immediate attention.

ROPER
HYDRAULICS INC.
BEDFORD,
ILLINOIS
AVIATION & SPECIAL PRODUCTS DIVISION

NEED A MORE RELIABLE SOURCE FOR ELECTRICAL CONNECTORS?

Airwork guarantees on-schedule delivery of custom assembled Genda® connectors to MIL Spec. MIL-1745. To order call 800-242-0744. Area Code 305, collect, or TWA 305-821-3723.

G.E.M. DIVISION

Airwork

P.O. BOX 48-154
INTERNATIONAL AIRPORT
MIAMI, FLORIDA



... today's promise ...

To creative engineers and scientists the tasks assigned to CHRYSLER Corporation SPACE Division hold out a tempting lure.

Chrysler's work as prime contractor on the long range SATURN I Program covers a broad span including performance improvement and development of new concepts for the vehicle.

Chrysler's long record of experience and success in the aerospace field, coupled with exciting present and future missions made up to the stimulating professional environment so sought after by the thoughtful.

If you look beyond today's activities to the horizons of tomorrow, a career with Chrysler can carry you to the full extent of your potential.

Chrysler activities on the Saturn I are divided among three congressional and present Southern

locations — NEW ORLEANS, HUNTSVILLE and CAPE CANAVERAL.

You hold a degree and have experience in any of the following: ADIOTHERMO MECHANICS, ELECTRICAL and ELECTRONICS, FLIGHT MECHANICS, TEST and LAUNCH OPERATIONS, MANUFACTURING, QUALITY CONTROL, RELIABILITY, STRUCTURAL, PROPULSION and RELATED ENGINEERING, or as a PROGRAMMER.

Send your resume, in complete confidence, to Section A-6, Personnel Department, at the location of your choice:

P.O. Box 26018, New Orleans 26, La.

P.O. Box 857, Huntsville, Ala.
1111 Sheridan Road, Milwaukee, Wis.

An equal opportunity employer.

SPACE DIVISION



CHRYSLER
CORPORATION



tomorrow's fulfillment ...

LIGHTPLANE ALTIMETER TRANSDUCER (left), made by General Electric, has a microswitch bellows mechanism to sense pressure changes, plus rotary disc encoder to digitize altitude data and gas flow to remote indicator board. Control head of transducer and altitude reporting system (right) enables pilot to select from 48 possible altitude scales at ground controller's instruction. Transponder will automatically transmit proper code when interrogated by traffic control radar.

FAA Evaluating Lightplane Transponders

By Barry Miller

Experimental altitude reporting transducers, designed to facilitate radar surveillance of light aircraft flying in controlled airspace, are in the initial stage of flight evaluation at the National Aviation Facilities Experimental Center, Atlantic City, N.J.

The equipment is being developed in parallel efforts by Beechtree Corp. and Tuncus Products, Inc., under the Small Lightweight Altitude Transducer Project, NASA Langley Research Center, Hampton, Va. Design of altitude transducers for light aircraft is based on ground interrogation with position, velocity and altitude information as a means of controlling the air traffic flow and improving safety.

One of State's principal goals is to encourage the development of light weight and low cost avionic equipment to enable lightplane users to be brought under positive air traffic control. The transponders would transmit automatic code to air traffic control center position finding codes, assigned to each light aircraft at an enroute ATC area, and altitude information as sensible means.

The goal is in conjunction with Project Beechtree recommendations which favor equipping all aircraft with transponders that respond automatically to ground interrogation with position, velocity and altitude information as a means of controlling the air traffic flow and improving safety.

The drawback for smaller aircraft users, however, has largely been one of cost. Even the most capable transponders being developed under State, should at least quadruple production rates cost the user as much as half the value of his aircraft.

The FAA's philosophy on State, explained Kenneth Wise, project engineer, is to determine the minimum necessary operational level for the airborne unit to do a satisfactory job and to find out what each increment of equipment capability will cost. Then the agency will be able to state cost and performance before mandatory requirements come under discussion.

In line with this reasoning, four separate types of equipment of increasing



SMALL LIGHTWEIGHT ALTITUDE TRANSMITTER EQUIPMENT (left) developed by Beechtree Corp., assisted by Kal-Beecon, is being evaluated by FAA. Equipment shown in left photo includes antenna (A), State 1 Mode control head (B) which permits selection of 4,000 feet altitude code; State 2 and State 3 control head (C) which has 64 codes; State 3 altitude transducer; altitude display (D); and transponder (E) which automatically transmits information upon interrogation by traffic controller. Components are at left. Right photo shows Beechtree's transponder, with cover removed, which is housed in metal EATC case. Visible functions include power supply (1), stack of three pulse encoder boards (2), delay line (3), RF duplexer and filter (4) and local oscillator (5). Transponder is derived from radar company-developed, FAA-supported general aviation transponder.



STATE 2 ALTITUDE reporting system, developed by Tencor Products, Inc., includes altitude transponder and antenna made by Gannett Controls, Inc.; lightweight transponder with 64 altitude codes and antenna. System makes possible accurate identification and automatic altitude reporting to ground controllers in 100 ft. increments up to 14,700 ft. This is one of the four State requirements of incoming equipment being developed by Tencor and now in early stages of FAA evaluation at the National Aviation Facilities Experimental Center in Atlantic City, N.J. Martin Corp. is conducting parallel development.

one component and capability are an overriding concern of development under State 2, with the first two types already in FAA's hands at NAFEC and an other, one scheduled for delivery in late October.

The four types are:

+ State 1—This system is designed for providing altitude information in 100 ft.

increments over a range of 50 mi from the interrogating source. The equipment consists of a transponder and antenna, a power transmitter for obtaining altitude and an associated digitizer. Both canistered and panel-mounted versions will be available.

The transponders differ in approach, but both have power outputs above

the 12 w minimum acceptable level specified by the FAA. Handheld transponders run about 50 w, those between 100 and 125. The transponders do not provide identification or tracking. As a result, each must be identified on a code-by-code basis. There is no digital attempt at a "missile" base power may have insufficient power output for general use, and the 500 ft reporting increments may be unsatisfactory.

* State 2—This version adds the ability to make mode A identification and permits the pilot to select one of 64 possible codes, but the transponders reduce the same power and sensitivity levels and the 100 ft altitude reporting is current accuracy unchanged. All State 2 equipment has been delivered to date.

* State 3—This system reduces altitude reporting increments from 100 ft. to 50 ft. to be certain that ground controllers will receive sufficient data on altitude and position to make safe conflicts. Eight panels. Additionally, State 3 equipment must meet more stringent environmental requirements, it to be more sensitive and capable of supplying a maximum of 100 w at the transponder antenna.

State 3 transponders will have 64 identity codes and probably will span a range of 300 mi. Unlike State 1 and

the 12 w minimum acceptable level specified by the FAA, Handheld transponders run about 50 w, those between 100 and 125. The transponders do not provide identification or tracking. As a result, each must be identified on a code-by-code basis. There is no digital attempt at a "missile" base power may have insufficient power output for general use, and the 500 ft reporting increments may be unsatisfactory.

* State 3, Model 1—State 3 capability is supplemented with a Model 1 transponder which adds an expanded 4,096 code selection. The two controllers are scheduled to deliver this equipment in October.

FAA now is evaluating State 1 and 2 equipment, but does not expect to report results until tests of all four types are completed, probably early next spring. The equipment is being flown in a Piper Tri-Pacer and will be checked in a Grumman California to qualify the test pins and to make longer range evaluations. Subsequently, the various equipments will be evaluated separately again, one another.

In typical possible operation, a light aircraft controller, a ground area with reported position, altitude, heading and destination, he will key the ground controller. If the pilot indicates that he has a transponder, he will be assigned an identity code, which he enters onto his transponder control head on the altitude measurement panel.

LOGIC OF TRANSPODERS State 2 transponder shows simple logic circuit used construction, compact packaging. Transponder weighs 4 lb., measures 14 in. long. It employs digital techniques for encoding signals.

Then, the State system will send altitude identification automatically in reply to an altitude control radio interrogator.

Typically, the Transon transponder will operate as follows: Interrogating signal from the ground controller causes the transponder to generate a pulse with dimensions similar to its section that pulses are of the proper amplitude and duration. If the pulses are legitimate interrogations, a pulse position detector associated with the altitude transducer or altimeter automatically sends its

between the interrogated pulse pair whether the interrogations are mode A (5 increases/repetitions) or mode C (1 increase/repetition).

If the signals are mode A, which it requires for identification, the transponder generates the coded identity number selected by the pilot in the 64 or 4,096 code selection. If the interrogations are in mode C, referred to as altitude reporting, the digitizer associated with the altitude transducer or altimeter automatically sends its

GREATER POWER in smaller packages for greater missions into space

Thanks to Lockheed Propulsion's Nitroplastisol formulations—which surpass all others in the rocket propellant industry because they combine in a single system these four essential attributes:

- 1) Safety in manufacture and use. 2) Proven high performance. 3) Simplified processing. 4) Excellent storability.

LOCKHEED

An extra-performance nitrocellulose base composite propellant capable of use over the entire range of environmental conditions now required of rocket motors, it is in current use in such programs as: The Army's Maser, ground to air missile; upper stages for classified space missiles, as well as the recently completed contract whereby LPC participates in propellant development for the Sprint missile—a part of the Nike-X anti-missile system.

With the development of Nitroplastisol (along with other major propellant systems) Lockheed Propulsion has now assumed a strongly competitive position in solid propellant technology. Constant experimentation with unusual ingredients is carried on in Company-funded research programs as well as under government sponsorship. Research for improving production propellants goes on 'round the clock.

As a result, these and other wide-ranging programs in high-energy formulations offer scientists and engineers genuine opportunity for growth



PRODUCTION COMPANY

REDLANDS, CALIFORNIA

A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

HAYDON SWITCH
INCORPORATED

SEALED Switches designed for environmental challenge!



RELIABLE,
GLASS TO METAL,
SEALED SWITCHES
ARE DESIGNED
FOR ENVIRONMENTAL
CHALLENGES IN BOTH
INDUSTRIAL AND MILITARY

Hydrex hermetically
sealed switches qualified
to MIL-E-5572 and
MIL-S-6743.



8 MIL. OPERATING LIFE
WITH DIRECT INPUT
Latching switch is suitable
for applications requiring
long life and reliability.
Switches are available
in standard or custom
configurations.



10000 CYCLES
LATCHING
Switch
Switches are made
from standard
components and
are designed for
use in harsh
environments.



STANDARD HYDREX
SWITCH
Offering low profile, compact
design, high reliability and
long life, these switches are
ideal for aircraft, space and
industrial applications.



HYDREX
SWITCHES
Offering low profile,
compact design,
high reliability and
long life, these switches are
ideal for aircraft, space and
industrial applications.

Write for New Product
Information Circular
Request Switch
Catalog. Haydon
Switch Incorporated
400 Main Street
Waterbury, Connecticut
06702
(203) 567-1140



WATERBURY, CONNECTICUT
PHONE 203-567-1140 • CABLE 1013

pulse train is the transponder which generates a reply to ground.

Torco's approach has a clock pulse generator for encoding the uplink on both modes. Naturally, transmitting and decoding are handled by a digital logic, and the elimination of the latter by the generator has made possible a sizable reduction in weight and expense, the company says. A digital logic apparently is used for decoding interrogations.

Using this approach, Torco has developed a compact transponder which in State 1 and 2 versions weighs only 4 lb., measures 34 in square by 18 in. at least. In Mark 1 version will be no longer; four more code slots will be added to account for the addition. The transponder is 100 percent solid-state.

Communication is almost entirely with solid-state components, the exception being a transmitting tube and two diodes that function as RF amplifier and local oscillator in the super heterodyne receiver. The transponder is sensitive to 1,050 mc, amounts on 1,090 mc, has echo suppressors to eliminate reflections, and three-pulse rate code suppression circuitry.

The State 1 transponder has a power down of 164 w, peak power output (maximum) of 100 w, and can provide response at distances in excess of 100 mi. in line-of-sight conditions, according to Torco. Receiver sensitivity is about -74 dbm. The pulldown time is about 100 microseconds.

The company's State 2 transponder is like the State 1 except for the 64 code selection.

State 3 transponder, according to Torco, provides 240 w output, requires less than 20 w. of power and has -74 dbm sensitivity. Mark 1 output power will stretch above 300 w peak and its weight is not expected to be over 5 lb.

Components in each of the seven transponders are grouped on 3-in. square ceramic boards with each board containing a specific function or basic function. Pulse pulse, pulse or pulse width discrimination. The transponders are packaged separately.

Torco reports it has been some of its State equipment as a company at odds, getting what it describes as erratic and dice results at distances over 150 mi.

Haydon's State transponder was derived from its earlier development under FAA sponsorship of a general aviation transponder which was somewhat of a forerunner to State. It did not have altitude encoding, but did have 64 code selection. That was a 16-bit unit, housed like the company's subsequent State transponders in a single 1 ATX box and providing more than 500 w output good for a range of about 150 mi.

WEATHERHEAD PNEUMATIC FLIGHT CONTROL

... Where it counts the most!

Weatherhead's pneumatic and hydraulic components and systems are strong in the industry's attention to many of today's advanced aerodynamics, spaceflight and ground support needs. We can help you experience the world on your special project requirements. Contact your nearby Weatherhead representative or write direct.



Pneumatic
Hydraulics
Hydraulic
actuator
systems
offer
the
advantages
of
light
weight
and
compact
size.
In
addition
to
standard
models,
Weatherhead
can
design
and
manufacture
systems
tailored
to
your
needs.



Assembly and Testing
Weatherhead's state-of-the-art test facilities provide the most complete assembly and testing environment for your flight control needs.

The Mark  of Quality
THE WEATHERHEAD COMPANY
Cleveland, Ohio

In State 1 equipment, including the Kellerman altitude digitor, is tightly housed, though it contains a transponder. This unit, however, is aimed at minimum cost operation and has maximum output power of less than 50 w. for 75 mi. range.

Like the Transon transponder, this version of State has a single short code, three pulse rate code suppression and 100 ft. altitude reporting capability. State 2 model has 64 altitude codes, but as other aspects are similar to State 1. State 3 transponder power output was increased to 100 w.

State 4 equipment is complete and State 3 Mark 1 with full altitude and velocity capability, and velocity report up to 14,500 ft. can be built.

Haydon's following conventional transponder design with which it has had extreme experience through BTF equipment designs and its general avionics transponder work.

Its Mark 1 transponder is expected to weigh about 20 lb. The State 3 transponder weighs about 115 lb, but with a lighter design recently performed, this model will not be down to 18 lb.

Both Weatherhead and Torco are seeking tentative plans for marketing State equipment, pending the outcome of FFA evaluations and the need and size of a market with and without user FAA representation. Haydon's plan is to keep the State 1 and 2 models as is to establish a revenue marketing arrangement. Both companies say they believe that they have outstanding State hardware and parallel all the arrangements made under a business aircraft model's trade show.

Torco says it is asking for a price to the end user for a State transponder, antenna and control lead of between \$1,500 and \$2,000. The Gossen site-rate digitor might add about \$2700 if made in 1,000-unit production runs, or \$119 in higher quantity runs, \$10,000. The ultimate digitor at production quantities might run about \$200. Haydon's State 1 and 2 transponders cost \$2,000 retail for State 1, Mark 1, or 23% less for State 3. Similarly, Kellerman costs \$150 for State 1 and 2 altitude transponders and about \$350 for State 3 altitude transponders.

All four manufacturers caution that these estimates are speculative, predicated on the emergence of a mature market. But they do provide potential users with a general guideline on potential prices.

Kellerman's State 3 altitude transducer which was scheduled for delivery to Atlanta City recently, is a precision encoding altimeter that provides an coded altitude transmission to the ground for transmission to ground. The altitude resolution is described as the company as a standard temperature compensated design, with outputs encoded by a combination mechanism in 100-ft.

increments from 1,000 to 15,000 ft. A follow-on servo system drives the encoder but does not feed the altitude information to the ground.

Gossen's State 1 and 2 altitude transducers are solid capsule whose outputs are linear with altitude. These are coupled by a band drive mechanism to the shaft of a linear to rotary converter which converts altitude information into a series of pulses. This pulse is then forwarded to the transponder. A counterweight gear assembly on the encoder shaft maintains positive error. The device weighs 43 lb.

Specifications first had to be met using an item of ±145 ft. at sea level increasing to ±325 ft. at the 15,000 ft. altitude.

Trade load. The average case for one transponder of the type is 15 kg. In Transon's case 45 lb. cost 32 altitude transducers costing since 65 ft. minimum transmission areas 60 ft., and temperature constant less than 30 ft.

To provide the visual readout of altitude for State 3, the same basic mechanism is employed, but with the addition of a gear train that rotates indicator hands on the display. There is also an adjustment provided for horizontal position correction. The passive adjustment allows the capsule and encoder assembly to return to its original reference position for the encoder.

we're pushin' cushion

The cushion we're pushing is KIMFRESH® K51, the new compressed isolator packaging material. We ship it to you squared — for your handling and storage economy. You stretch it as you use it. Send a coupon for a FREE working sample. Try KIMFRESH at home, then consider how it might save precious costs in your plant.

 **Kimberly-Clark**

Name	Title
Company	
Address	
City	State
My home address	
City	State
Phone	
#	
Name	Title
Company	
Address	
City	State
My home address	
City	State
Phone	
Mail to: Kimberly-Clark Corp., KIMFRESH Dept. K51, Newark, NJ.	

U.S. Business & Utility Aircraft Shipments

Note: All calculations for the Updates in Distribution and Periodic Service were conducted with software in this table on 1,000 concurrent testing sites. Testing sites with more than 1,000,000,000 unique IP addresses or 1,000 concurrent stations resulted in a total testing failure rate of more than 10% due to the same error.

PRIVATE LINES

length of time a person should be allowed taking a given drug before acting as a crew member in an aircraft, in line with provisions of Federal Aviation Regulation 91.16(a) (b).

Federal Aviation Agency has issued a publication, entitled Guide to Drug Hazards in Aviation Medicine, which consists of a list of all contraindicated prescription and nonprescription drugs and notes possible side effects. Let makes recommendations concerning the use of these drugs.

CAREER OPPORTUNITIES IN THE **5 AREAS OF DALMO VICTOR SYSTEM CAPABILITIES**

The exponential increase in the number of patients after initiation of challenges. Gain of further contributions in five chosen areas of speculation on other cancer opportunities in case of chronic lymphocytic and small-cell lung cancer.

- AIRBORNE ANTENNAS** important part of the successful operation of land-based strategic weapons systems. Computer-aided performance analysis packages for search and track, search, ballistic, ground mapping, the control and a host of other projects.

2020 RELEASE UNDER E.O. 14176

Massive present: listed command and control platform provides tracking and communication features for unique mining deep space operations. Delmo Miner has the ability to list off of producing complex samples from basic metals to precious.

3 Macmillan Science Online

It is encouraging to note that the U.S. has been deeply committed to migration systems for many years. Leadership to other institutions in technology, outcome tracking, continuous measurement, and distance measuring with regard to the various choices would be justified and will further help our

4-16-2010 2:10 PM

Yester achievement was, without doubt, unique development in anti-cultural and popular culture systems, a special stabilization of Chinese culture system, and other contributions to the political and its related fields.

5 中国古典文学名著全集·古典文学研究

primarily from within California. Testimony is available on whether lead can contribute, (from Vinton) a wider range of ground support than ground disturbance (from Johnson), from a highly effective combination of 10 miles and tonnes (from Vinton) provides important single source information.

The page opposite describes one of many Dulme Miller's achievements. Salesmen and engineers of unusual ability are needed to further this and other basic needs.

Point Conception is your answer to all this yearning of independence, quiet and the many advantages of living in the San Francisco Peninsula area. West Hollywood is closer than Del Mar. Venice is just around the corner.



DALMO VICTOR EXTENDS NAVY'S "SEE" AT SEA "Rotorsonic" antenna system, a Dalmo Victor development, is a key factor in the early warning system that gives the fleet increased threat detection and weapon deployment. The "Rotorsonic" antenna structure combines aerodynamic, pleural, micro-wave and mechanical design concepts into a single and which is an integral part of the carrier-based Grumman Hawkeyes. This super-sensitive, long-range detection equipment is another example of Dalmo Victor's fully integrated systems capability. Dalmo Victor is in the vanguard of new developments in its major product areas. If you are interested in becoming a part of these challenging programs, Dalmo Victor is currently inviting applications from qualified scientists and engineers. Furthermore information contact Director, Scientific and Engineering Personnel. An Equal Opportunity Employer.

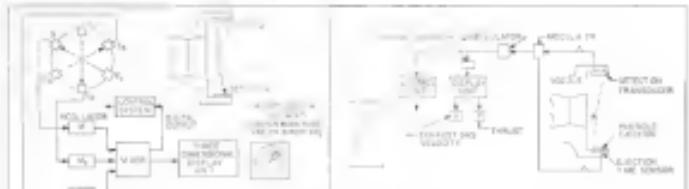


©ALMO KISTERS COMPANY. THIS DOCUMENT IS THE PROPERTY OF ALMO KISTERS COMPANY.



J. ELECTRICAL CHAMPAGNE

EQUIPMENT



BLOCK DIAGRAM (left) shows outputs from the detection transducers—S₁, S₂ and S₃—to the position electronics, which would send an output signal to the guidance and control system. Diagram (right) traces output from those outputs.

Thrust Vectoring Monitor Demonstrated

By Rodenick D. Hibben

PROJECT: F-111 and other Aerospace Programs

MAJOR open in: ASSIGNMENTS

**SYSTEMS ANALYSIS
AND DESIGN-**
Population, Radar, Flight Controls,
Servo Controls, and Fuel Systems
ANALYSIS—Stress, Flutter and Dynamics,
Structural Loads and Criteria, Reliability,
Maintainability, Thermos, and Environmental
STABILITY AND CONTROL
AERODYNAMICS
STRUCTURAL DESIGN



Qualified engineers and scientists of virtually every discipline are needed to fill important openings — now! ■ Living in Fort Worth, you'll enjoy excellent cultural, educational and recreational facilities; mild climate, clean, smog free air; uncongested freeways; and economical living. ■ Take advantage of present opportunities — send a resume of your training and experience to J. B. ELLIS, Industrial Relations Administrator Engineering, General Dynamics / Fort Worth, P. O. Box 748, Fort Worth, Texas. An equal opportunity employer.

GENERAL DYNAMICS | FORT WORTH

pulse associated with the thrust a also increased by the system.

Possibility of a continuous thrust vector monitoring system—which uses metal pellets injected into a rocket exhaust stream—has been demonstrated by Random Laboratories, Inc., Newark, N. J., under a contract from the U. S. Air Force.

The monitoring device developed by Random for Aerospace Systems Div.'s Flight Control Laboratory, Wright-Patterson AFB, Ohio, suggests eventual development of a system designed to provide thrust vector control and guidance of jet aircraft, rockets and missiles through continuous probing of exhaust plumes with the small pellets. Total en-

gine thrust can be measured by a sensor mounted with the thrust a also increased by the system.

The device, called a gas dynamic aneroid, is analogous to a cathode-ray oscilloscope, but traces pellets fed into the exhaust stream from three explosive ports spaced 120 deg apart or from one point rotated around the nozzle. The force or deflection exerted on the pellet is directly proportional to the engine thrust. Knowledge of the pellet's trajectory and the period of time required for it to be deflected at given distances allows determination of the thrust magnitude.

The thrust is the integral of the jet under thrust equation used over the pellet's time of flight. The deviation of

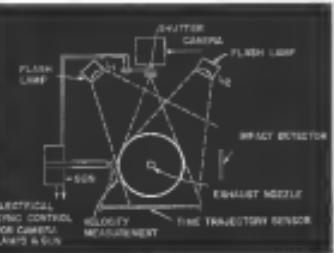
the thrust vector from constant is obtained from first deflection number.

Experiments at Random Laboratories were conducted in a cold plate environment. Low temperature nitrogen gas was used in the initial experiments because of a need for a component having a flat background that would permit the use of normal photographic equipment. This particular technique was chosen because it is a fast, low-cost way to expand the information available to the atmosphere through a dotted rectangular rate.

Individual streams of turbulent pellets and pellets coated with an fluorescent dye are being considered for aerial



THRUST VECTOR MONITORING SYSTEM is contained in a 4.0-dia cylinder (left). Gas flow is directed out from the nozzle into the center. Pellets are ejected from the pipe at center right and travel from right to left. Block A below is the dynamic detection system. Block B to right is photo cells set up to detect light reflected off pellets as captured by 90-deg prisms located below each of the two mass fluxes in dynamic detection system and then sent through two amplifiers (not shown). When the thrust vector bends down, it rotates a solenoid valve at extreme right end, which opens pressure gas atop the rectangular slit. Random control configuration options include cameras, flux gate, velocity transducer, gas flow and spectrum systems. Schematic (right) shows another test configuration.



INTERNATIONAL AIR TRANSPORT **ISSUE**

October 7, 1963

To meet the information challenge created by the international character of aviation, AN IATION WEEK & SPACE TECHNOLOGY publishes each year an issue devoted to international air transport progress. This issue is received with enthusiasm and response that it will again be greatly expanded to provide the most comprehensive analysis and forecast of the air transportation industry and its technical developments.

Publishing date is October 7, 1969, timed to coincide with the annual general meeting of the International Air Transport Association (IATA) in Rome. Copies of the issue will be flown to Rome for distribution at the opening plenary session to airline presidents, IATA delegates and other world aviation leaders.

Some theme will be the current problems in international air transport including bilateral agreements, rates and tariffs, high equipment, passenger, mail and cargo traffic, air traffic control, the expansion over exchange of international routes. Other subjects essential to a full analysis of the airline industry world will be stressed including trends in air passenger transport development, military transport operation, services of Russian and Commonwealth Bloc airlines, impact of U.S. international transport policy on world political and cultural relations.

Future forecasts will be given in trends and projected future prospects for traffic growth and development of flight assignment in all major world markets. North and South America, Atlantic, Pacific, Europe, Africa, Middle and Far East. Ample illustrations will also contain specially prepared charts and graphs to show growth and forecast results.

This impressive list of target clients for our agency will involve the world-wide editorial staff of AVIATION WEEK & SPACE TECHNOLOGY. Thousands of the world's data are published with AVIATION WEEK, a publication as authoritative as any in the field of international aviation. Your promise to us is the most important advertising opportunity of the year for your equipment products and services to the airlines. Identify your role in air transport at a time when attention will be focused on major industry needs.



Aviation Week
& Space Technology



A Division of **W.H. Freeman**, 100 West 42nd Street, New York, N.Y. 10036

Triple-Test Simulator Assembled

fluorescence, emission of Xe^+ ions, electrons and ion energies exceeding 3.5 keV, and rotation of the Xe^+ ion beam on a variable transverse environmental gas provide a simulation system enabled by Anatech Corp., Argonne Project Manager, Office, Illinois, 60616. The equipment will be used to study possible changes in electrical and optical properties of exposed metal surfaces of aerospace and other devices due to effects of low energy particles typical of those in the outer region.

space vehicle flight control applications where temperature and load extremes, corrosion resistance, magnetic or non-magnetic and dielectric properties

that the intake systems can be located near the exhaust plane.

threat generated by the Raudow test increased from 70 to 140 lbs., 100 lbs.

using the nominal value during normal operation. Chrome steel pellets of about 10 mm. dia. and weighing 2 kilograms were used. Pellet injection rates up to 5 per sec. can be attained at present. One tonne of each of the pellets contains about 14,000 pellets and weighs 3.1 on a 3.18 lb. test strength unit which would last 40 hr. A Train maximum would require about 600 kg. of pellets.

Janice Green, Marketing

The aerothermal method of measuring thrust is through the use of strain gauges bonded on the engine mounting bolts. In new jet aircraft, thrust vectors are measured with strain gauges. Any slight deviation from consistency of the thrust section are corrected by shrinking the pylon/strut mounting structure.

The strain gage method is limited to ground measurements while the system proposed by Rausch could be used in flight vehicles and as a research tool for dynamic analysis of aircraft profile parameters. Strain gages are accurate to about 1%. The measuring accuracy becomes a limitation when thrust levels of 980,000 to 1,980,000 lb are being measured.

According to Random, the flight 100-hour monitoring system can reduce flight time to about 8.9% of 100.

Other possible applications of the
matrix are the classifications of burn-

FEATURE FOR FEATURE
NO OTHER VALVE
WILL PERFORM AS WELL

1100° F / 400° C



VAP-AIR IN-LINE AIR VALVE

- Unaffected by ambient temperature (from -65°F to +140°F), and temperatures to 1100°F, due to pressure to 400 psi
 - Compact and lightweight
 - One-piece monolithic seal in comparison to rivet
 - Fast assembly, tight closure
 - Only one moving part
 - Operates at any altitude
 - Completely reliable and safe
 - Low pressure drop
 - Available in sizes from 1" to 3"

The 110° diameter on/off ball valve allows remote valve control. It is a system for remote valve control without piping. Piping configuration can be made to your specification. Increases your application when you have compact facilities or design, development, engineering, manufacturing and procurement of test chamber systems and a source for all types of pressure, temperature, control, pneumatic, liquid isolation and air flow pneumatic systems. With its built-in off-the-shelf valves, bypass valves and various mechanical valves, balanced load air valves, pressure regulators, balanced load air valves, pressure regulators, balanced load air valves, pressure regulators,

© 2007 KUTV-TV, Salt Lake City



© 1982 VAPOR CORPORATION





"SPACE" IS OUR PRODUCT
SERVING THE needs of the Aerospace Industry

**JOSEPH L. SMITH
and Associates**
2571 H MCGREGOR DRIVE • HOUSTON 4, TEXAS
JA 6-3321

(On your first trip to the space shop by
our branch office for coffee.)

WE ARE SPECIALISTS IN SPACE OF ALL KINDS . . .

We will DESIGN IT, ENGINEER IT, FINANCE IT, BUILD IT, MANAGE IT,
LEASE IT . . . BUY IT OR SELL IT.

SPACE . . . IN OFFICE BUILDINGS, INDUSTRIAL COMPLEXES, RESEARCH
FACILITIES, APARTMENTS, HOTELS, SHOPPING CENTERS, OR UNDEVELOPED
LAND.

We are NASA Area's leading Real Estate Agency and often one of the
leading owner of numerous trusts near the MANAGED SPACECRAFT CENTER
or CLEAR LAKE for both users and INVESTORS.

WE HAVE JUST BUILT AND LEASERED TO NASA their largest single location
in the Houston Area.

JOSEPH L. SMITH and Associates will represent you in a confidential and
professional basis. Write or call for an appointment or interview.

PROBLEMATICAL RECREATIONS 185



On a certain day, our parking lot contained 259 cars, no two of which have the same 3-digit license number. After 5:00 pm what is the probability that the license numbers of the first 4 cars to leave the parking lot are in increasing order of magnitude?

—continued

Costal on our USRCO Top-Half component line of retaining clevises for positive retention of plug-in components. Available in nearly all styles and sizes. For round-robin, round-sleeved, rectangular, other configurations. Also check us for electronic hardware, thermal buses, encapsulation rigs, multi-layer, weldable and conventional printed circuit boards. Write U.S. Engineering Co. Inc., 13335 Keeley St., Van Nuys, Calif.

ANSWER TO LAST WEEK'S PROBLEM: The two slugs have exactly the same rate to themselves.

LITTON INDUSTRIES, INC.
Beverly Hills, California

WHO'S WHERE

(Continued from page 21)

Changes

John A. Cornell, newest department manager, Communications, Systems Development, Corp., Santa Barbara, Calif.

Edna F. Nichols, manager of the newly formed Advanced Plasma and Research Dept., Hughes Aircraft Co., Fullerton, Calif. Also East Schools project engineer. Hiller Aircraft Co.'s helicopter program.

John D. O'Farrell, new manager of plasma physics project, Racetrack Power, Inc., with headquarters at the company's Research Laboratories, Menlo Park, Calif.

C. W. Gates, Maintenance with long history as a design engineer, now at General Electric Co., Schenectady, N.Y.

Capt. Donald J. Bellamy, manager, Aviation Transport Div. of Textron, Inc., New York, N.Y.

Col. William H. Radley, deputy project manager for engineering activities, Nike Zeus Project, Lockheed Missiles and Space Company, Sunnyvale, Calif.

Frederick E. Bassett, director of engineering, Spacelab Division, Space General Corp., El Segundo, Calif.

Capt. Charles F. Steward, manager of flight operations, United Air Lines, moved to Capt. John C. Gandy.

J. Frank Higgins, manager engineering research, Astro Research Corp., Washington.

Charles J. Rock, manager director of test programs, Martin Co., Belmont.

A. M. Cheshire, manager of requirements management, Space Division, General Dynamics Corporation, San Diego, and R. A. Gleason, manager of requirements research, test and analysis systems.

Dr. Lawrence R. Sheldahl, Jr., director, IBM Research Laboratories, Tokyo, Japan, and Robert H. Pollard, manager of ad

ministrative and technical services, IBM Corp., Executive Div., Aerospace Corp., Ft. Monmouth (N.J.) Technical Operations.

Stanley Russell, senior project engineer, Lockheed Missiles and Space Co., Sunnyvale, Calif.

William E. Williams, manager of operations, Western Div. of Trintec Engineering Inc., South Gate, Calif.

Stanley J. Kowalski, director of quality control, McDonnell-Douglas Div. of Boeing, Inc., Long Beach, Calif.

Dr. Joseph F. Coffey, chief of space control division, Brush Systems Div., Avco Astrotech, Inc., Woburn, Mass.

Col. John W. Choudhury USAF (ret) manager of communications, Technical Test Division, Bell Telephone Co., Fort Monmouth, N.J.

Dr. William H. Glazebrook, manager, Microwave Test Div., Hughes Aircraft Co., Culver City, Calif., and Dr. John T. Meister, research manager.

Anthony M. Johnson, marketing manager, Special Projects Div., Baldwin Locomotive Works, Philadelphia, Pa.

Dr. Robert E. Moore, senior research engineer, East McCollough, Inc., San Carlos, Calif.

R. L. Thorne, director of engineering, Lockheed-California Co., Burbank, Calif., replacing J. B. Wren, now on leave of absence.

ENGINEERS & SCIENTISTS

ALL CHIEFS, NO INDIANS !

With targets in check, this phrase might be applied to the scientists and engineers of Pan Am's Guided Missiles Range Division. Under the direction of the U.S. Air Force Missile Test Center, GMRD has since 1958, been responsible for conceptual planning, specification, and operation of the range instrumentation systems developed by industry for the Atlantic Missile Range. The decisions made by Pan Am's leaders in GMRD are vital, directly affecting the success of each missile, space vehicle, and scientific probe launch operation at Cape Canaveral.

RANGE PLANNING analyzes projected program requirements up to 10 years ahead, provides range support capability required and develops the detailed instrumentation system concept.

SYSTEMS ENGINEERING utilizes these range plans to develop detailed specifications for all range instrumentation, data, and support systems. They then evaluate bids from industry to insure that capable industry sources will furnish such systems. This is only the beginning of their task—they follow and monitor the development of this equipment through test fixtures and checkout.

RANGE OPERATIONS plans and evaluates range support for all launches, coordinates all range support activities, provides data and command/demand for range safety, and manages the operation of diverse range systems.

Radiotherapy and its uses, methods, the uses in cancer treatment and other medical technology. This is the beginning of the range of the public health types who are presented on page 16. Range Planning, Systems Engineering, and Range Operations.

GW and Pulsar Radar modify and improve sensitivity of instruments, Clinton, Arkansas and ATLAS-IV driving velocity measuring systems with an accuracy of ±1% Q.E.

Velocity increases the operating range of instruments to never before seen in 2000 ft/sec. These include new command, tracking, and data equipment from various sources.

Options, design and install an orientation system for both CDR and chart-tablet, hydrotite flightline cameras with respect to random errors, stellar speed, aperture loss and lens aberrations.

Reliability during high resolution experiments for French and German agencies implements a complete thermal measurement system for data storage and analysis.

Universal Beam, introduces a novel beam power supply that can step conductive current (blue) and extend the range of this option.

Beam Profiling, with universal methods to enable space applications, the use of various beam only instruments depends upon the need of particular information to be taken.

Microsatellite improves flight and ground data collection techniques, developing a system to measure environmental electrical potential and thermal emission.

Capable engineers and scientists with applicable experience are invited to write to: Director, Range Development, Dept. 144-1



**GUIDED MISSILES
RANGE DIVISION**

PAN AMERICAN WORLD AIRWAYS, INC.
P.O. BOX 4465 PATRIOT AIR FORCE BASE, FLORIDA

An Equal Opportunity Employer

ADVANCED SYSTEMS ENGINEER

AERIAL MAPPING

To be responsible for developing mapping system concepts. To evaluate the latest ground processing equipment, and for generating system concepts, and performing analytical studies and review systems in the field systems interface.

Requires advanced degree preferably P.D. or physics or engineering plus extensive related experience in the field of photogrammetry, geodesy, or related fields including theoretical and practical experience. Must be familiar with analytical semi-automatic, involving the mapping sciences and applications.

Bell Aerospace's entry into the aerial mapping field is a result of the Company's success with HIPIEVAS (High Performance Multisensor System), the most accurate, most compact, low-cost compensating sensor and processor system. Further positioning is continuing, creating the opening described above. Submit resume to ERSB.

Please address resume to Mr. Thomas Pataki, Dept. B-26
 BELL AEROSYSTEMS CO.
 DIVISION OF BELL AERONAUTICAL CORPORATION/A SUBSIDIARY COMPANY

An Equal Opportunity Employer F.O. BOX #1, BUFFALO 5, NEW YORK

"Put Yourself in the Other Fellow's Place"

TO EMPLOYERS TO EMPLOYEES

Industries often allow employees to request 10 days off within the term of employment to attend local or national meetings at which it is desired or set to receive special training.

MR. DIRECTOR: Since you control the money and majority of your employee's activities for determining off-schedule and not the remaining schedule.

MR. EMPLOYEE: Now this can help to determine who your employer and job allows. The usual assumption most companies to assume position would not be correct.

We note in its support in a total of 10 days' suspension from your employer and employer. This will be the more useful as it is much of the time cumulative.

Classified Advertising Boxes

MURKIN-HILL POLISHING CO., INC.
 230 West 42nd St. New York, N.Y. 10036

EXECUTIVE VISCOUNT
 A British banker turned by fate into diamond dealer. New wealth with complete care and attention to the private and industrial uses of diamonds. Training: Aviation United International Diamond Graduate.

FLEET EXPANSION MAKES AVAILABLE SHARP BURROUGHS CORPORATION DOVE N.70.

Estimates of lessors available for your Fleet may fit this plane perfectly to your needs and available for sale \$10,000 down and \$1,000 per month. F113-42-2011 (Rev. 10 Dec 1966) (Model) (overhauled) Mid engines. Herkules Intensity. American Prop. 1000 ft. H.P. 1000 ft. RPM. 1000 ft. RPM. GMA Dallas Area. Mid Axis Bank and Steerwheels. Complete system power pack includes no cooling. 1000 ft. RPM. 1000 ft. RPM. 1000 ft. RPM. All new parts and service. Mid axis servos and special tools. Immediately removable and operable.

LOCKHEED 1049H's FOR SALE OR LEASE

142,000 Tons OH Weight—Convertible 50 Seat Interior
 Loaded with Spare Parts & Quick Engine Changes
 New Operating MATS Contract
 Sole—Exceptionally Low Instalments

TRANS INTERNATIONAL AIRLINES INC.

F.O. Box 2306 Airport Station

Oakland, California

589-8993

Mobile Office Trailers
 DODGE
 1968
 1969
 1970
 1971
 1972
 1973
 1974
 1975
 1976
 1977
 1978
 1979
 1980
 1981
 1982
 1983
 1984
 1985
 1986
 1987
 1988
 1989
 1990
 1991
 1992
 1993
 1994
 1995
 1996
 1997
 1998
 1999
 2000
 2001
 2002
 2003
 2004
 2005
 2006
 2007
 2008
 2009
 2010
 2011
 2012
 2013
 2014
 2015
 2016
 2017
 2018
 2019
 2020
 2021
 2022
 2023
 2024
 2025
 2026
 2027
 2028
 2029
 2030
 2031
 2032
 2033
 2034
 2035
 2036
 2037
 2038
 2039
 2040
 2041
 2042
 2043
 2044
 2045
 2046
 2047
 2048
 2049
 2050
 2051
 2052
 2053
 2054
 2055
 2056
 2057
 2058
 2059
 2060
 2061
 2062
 2063
 2064
 2065
 2066
 2067
 2068
 2069
 2070
 2071
 2072
 2073
 2074
 2075
 2076
 2077
 2078
 2079
 2080
 2081
 2082
 2083
 2084
 2085
 2086
 2087
 2088
 2089
 2090
 2091
 2092
 2093
 2094
 2095
 2096
 2097
 2098
 2099
 20100
 20101
 20102
 20103
 20104
 20105
 20106
 20107
 20108
 20109
 20110
 20111
 20112
 20113
 20114
 20115
 20116
 20117
 20118
 20119
 20120
 20121
 20122
 20123
 20124
 20125
 20126
 20127
 20128
 20129
 20130
 20131
 20132
 20133
 20134
 20135
 20136
 20137
 20138
 20139
 20140
 20141
 20142
 20143
 20144
 20145
 20146
 20147
 20148
 20149
 20150
 20151
 20152
 20153
 20154
 20155
 20156
 20157
 20158
 20159
 20160
 20161
 20162
 20163
 20164
 20165
 20166
 20167
 20168
 20169
 20170
 20171
 20172
 20173
 20174
 20175
 20176
 20177
 20178
 20179
 20180
 20181
 20182
 20183
 20184
 20185
 20186
 20187
 20188
 20189
 20190
 20191
 20192
 20193
 20194
 20195
 20196
 20197
 20198
 20199
 20200
 20201
 20202
 20203
 20204
 20205
 20206
 20207
 20208
 20209
 20210
 20211
 20212
 20213
 20214
 20215
 20216
 20217
 20218
 20219
 20220
 20221
 20222
 20223
 20224
 20225
 20226
 20227
 20228
 20229
 20230
 20231
 20232
 20233
 20234
 20235
 20236
 20237
 20238
 20239
 20240
 20241
 20242
 20243
 20244
 20245
 20246
 20247
 20248
 20249
 20250
 20251
 20252
 20253
 20254
 20255
 20256
 20257
 20258
 20259
 20260
 20261
 20262
 20263
 20264
 20265
 20266
 20267
 20268
 20269
 20270
 20271
 20272
 20273
 20274
 20275
 20276
 20277
 20278
 20279
 20280
 20281
 20282
 20283
 20284
 20285
 20286
 20287
 20288
 20289
 20290
 20291
 20292
 20293
 20294
 20295
 20296
 20297
 20298
 20299
 20300
 20301
 20302
 20303
 20304
 20305
 20306
 20307
 20308
 20309
 20310
 20311
 20312
 20313
 20314
 20315
 20316
 20317
 20318
 20319
 20320
 20321
 20322
 20323
 20324
 20325
 20326
 20327
 20328
 20329
 20330
 20331
 20332
 20333
 20334
 20335
 20336
 20337
 20338
 20339
 20340
 20341
 20342
 20343
 20344
 20345
 20346
 20347
 20348
 20349
 20350
 20351
 20352
 20353
 20354
 20355
 20356
 20357
 20358
 20359
 20360
 20361
 20362
 20363
 20364
 20365
 20366
 20367
 20368
 20369
 20370
 20371
 20372
 20373
 20374
 20375
 20376
 20377
 20378
 20379
 20380
 20381
 20382
 20383
 20384
 20385
 20386
 20387
 20388
 20389
 20390
 20391
 20392
 20393
 20394
 20395
 20396
 20397
 20398
 20399
 20400
 20401
 20402
 20403
 20404
 20405
 20406
 20407
 20408
 20409
 20410
 20411
 20412
 20413
 20414
 20415
 20416
 20417
 20418
 20419
 20420
 20421
 20422
 20423
 20424
 20425
 20426
 20427
 20428
 20429
 20430
 20431
 20432
 20433
 20434
 20435
 20436
 20437
 20438
 20439
 20440
 20441
 20442
 20443
 20444
 20445
 20446
 20447
 20448
 20449
 20450
 20451
 20452
 20453
 20454
 20455
 20456
 20457
 20458
 20459
 20460
 20461
 20462
 20463
 20464
 20465
 20466
 20467
 20468
 20469
 20470
 20471
 20472
 20473
 20474
 20475
 20476
 20477
 20478
 20479
 20480
 20481
 20482
 20483
 20484
 20485
 20486
 20487
 20488
 20489
 20490
 20491
 20492
 20493
 20494
 20495
 20496
 20497
 20498
 20499
 20500
 20501
 20502
 20503
 20504
 20505
 20506
 20507
 20508
 20509
 20510
 20511
 20512
 20513
 20514
 20515
 20516
 20517
 20518
 20519
 20520
 20521
 20522
 20523
 20524
 20525
 20526
 20527
 20528
 20529
 20530
 20531
 20532
 20533
 20534
 20535
 20536
 20537
 20538
 20539
 20540
 20541
 20542
 20543
 20544
 20545
 20546
 20547
 20548
 20549
 20550
 20551
 20552
 20553
 20554
 20555
 20556
 20557
 20558
 20559
 20560
 20561
 20562
 20563
 20564
 20565
 20566
 20567
 20568
 20569
 20570
 20571
 20572
 20573
 20574
 20575
 20576
 20577
 20578
 20579
 20580
 20581
 20582
 20583
 20584
 20585
 20586
 20587
 20588
 20589
 20590
 20591
 20592
 20593
 20594
 20595
 20596
 20597
 20598
 20599
 20600
 20601
 20602
 20603
 20604
 20605
 20606
 20607
 20608
 20609
 20610
 20611
 20612
 20613
 20614
 20615
 20616
 20617
 20618
 20619
 20620
 20621
 20622
 20623
 20624
 20625
 20626
 20627
 20628
 20629
 20630
 20631
 20632
 20633
 20634
 20635
 20636
 20637
 20638
 20639
 20640
 20641
 20642
 20643
 20644
 20645
 20646
 20647
 20648
 20649
 20650
 20651
 20652
 20653
 20654
 20655
 20656
 20657
 20658
 20659
 20660
 20661
 20662
 20663
 20664
 20665
 20666
 20667
 20668
 20669
 20670
 20671
 20672
 20673
 20674
 20675
 20676
 20677
 20678
 20679
 20680
 20681
 20682
 20683
 20684
 20685
 20686
 20687
 20688
 20689
 20690
 20691
 20692
 20693
 20694
 20695
 20696
 20697
 20698
 20699
 20700
 20701
 20702
 20703
 20704
 20705
 20706
 20707
 20708
 20709
 20710
 20711
 20712
 20713
 20714
 20715
 20716
 20717
 20718
 20719
 20720
 20721
 20722
 20723
 20724
 20725
 20726
 20727
 20728
 20729
 20730
 20731
 20732
 20733
 20734
 20735
 20736
 20737
 20738
 20739
 20740
 20741
 20742
 20743
 20744
 20745
 20746
 20747
 20748
 20749
 20750
 20751
 20752
 20753
 20754
 20755
 20756
 20757
 20758
 20759
 20760
 20761
 20762
 20763
 20764
 20765
 20766
 20767
 20768
 20769
 20770
 20771
 20772
 20773
 20774
 20775
 20776
 20777
 20778
 20779
 20780
 20781
 20782
 20783
 20784
 20785
 20786
 20787
 20788
 20789
 20790
 20791
 20792
 20793
 20794
 20795
 20796
 20797
 20798
 20799
 20800
 20801
 20802
 20803
 20804
 20805
 20806
 20807
 20808
 20809
 20810
 20811
 20812
 20813
 20814
 20815
 20816
 20817
 20818
 20819
 20820
 20821
 20822
 20823
 20824
 20825
 20826
 20827
 20828
 20829
 20830
 20831
 20832
 20833
 20834
 20835
 20836
 20837
 20838
 20839
 20840
 20841
 20842
 20843
 20844
 20845
 20846
 20847
 20848
 20849
 20850
 20851
 20852
 20853
 20854
 20855
 20856
 20857
 20858
 20859
 20860
 20861
 20862
 20863
 20864
 20865
 20866
 20867
 20868
 20869
 20870
 20871
 20872
 20873
 20874
 20875
 20876
 20877
 20878
 20879
 20880
 20881
 20882
 20883
 20884
 20885
 20886
 20887
 20888
 20889
 20890
 20891
 20892
 20893
 20894
 20895
 20896
 20897
 20898
 20899
 20900
 20901
 20902
 20903
 20904
 20905
 20906
 20907
 20908
 20909
 20910
 20911
 20912
 20913
 20914
 20915
 20916
 20917
 20918
 20919
 20920
 20921
 20922
 20923
 20924
 20925
 20926
 20927
 20928
 20929
 20930
 20931
 20932
 20933
 20934
 20935
 20936
 20937
 20938
 20939
 20940
 20941
 20942
 20943
 20944
 20945
 20946
 20947
 20948
 20949
 20950
 20951
 20952
 20953
 20954
 20955
 20956
 20957
 20958
 20959
 20960
 20961
 20962
 20963
 20964
 20965
 20966
 20967
 20968
 20969
 20970
 20971
 20972
 20973
 20974
 20975
 20976
 20977
 20978
 20979
 20980
 20981
 20982
 20983
 20984
 20985
 20986
 20987
 20988
 20989
 20990
 20991
 20992
 20993
 20994
 20995
 20996
 20997
 20998
 20999
 20100
 20101
 20102
 20103
 20104
 20105
 20106
 20107
 20108
 20109
 20110
 20111
 20112
 20113
 20114
 20115
 20116
 20117
 20118
 20119
 20120
 20121
 20122
 20123
 20124
 20125
 20126
 20127
 20128
 20129
 20130
 20131
 20132
 20133
 20134
 20135
 20136
 20137
 20138
 20139
 20140
 20141
 20142
 20143
 20144
 20145
 20146
 20147
 20148
 20149
 20150
 20151
 20152
 20153
 20154
 20155
 20156
 20157
 20158
 20159
 20160
 20161
 20162
 20163
 20164
 20165
 20166
 20167
 20168
 20169
 20170
 20171
 20172
 20173
 20174
 20175
 20176
 20177
 20178
 20179
 20180
 20181
 20182
 20183
 20184
 20185
 20186
 20187
 20188
 20189
 20190
 20191
 20192
 20193
 20194
 20195
 20196
 20197
 20198
 20199
 20200
 20201
 20202
 20203
 20204
 20205
 20206
 20207
 20208
 20209
 20210
 20211
 20212
 20213
 20214
 20215
 20216
 20217
 20218
 20219
 20220
 20221
 20222
 20223
 20224
 20225
 20226
 20227
 20228
 20229
 20230
 20231
 20232
 20233
 20234
 20235
 20236
 20237
 20238
 20239
 20240
 20241
 20242
 20243
 20244
 20245
 20246
 20247
 20248
 20249
 20250
 20251
 20252
 20253
 20254
 20255
 20256
 20257
 20258
 20259
 20260
 20261
 20262
 20263
 20264
 20265
 20266
 20267
 20268
 20269
 20270
 20271
 20272
 20273
 20274
 20275
 20276
 20277<br

LETTERS

Supersonic Boom

The article appearing in the July 15 issue of Aviation Week by pilot testing Mgr. L. B. Mayes's viewpoints in support of a Mach 2 supersonic transport represents in my opinion, a gross mismanagement of facts.

We're going to cover hours the article implies that the same basic ground over previous aircraft does not hold true for a Mach 1.5 SST, due to a Mach 1.5 SST's greater potential for performance. The following information is available to indicate that a Mach 1.5 SST could, at \$6,000/lb., will produce a lower boom ignition overpressure of approximately 0.1 psi greater than a Mach 1.60 SST, resulting at \$4,800/lb. It does not follow, however, to be of 300 psi greater than the Mach 1.5 SST's original. During the climb and acceleration phase of the flight, the maximum value of ground overpressure may be expected to occur between Mach 1.2 and Mach 1.7 as that the sonic boom is not yet visible to the eye. At this point, the Mach 1.5 SST's two vehicles in this phase of the flight.

In addition, the deceleration and descent phase of the flight is again equal to much of a problem from some basic considerations. At Mach 1.55T, as it would be for the Mach 1.5 SST, the aircraft would have to find a constant altitude deceleration to keep supersonic. Much mention goes to my descent. Any complicated procedure prior to descent is indicated by Mr. Mayes to be required. The Mach 1.5 SST will also be required with the Mach 2 SST.

The article further states that passengers on a Mach 1.5 SST traveling 2,345 mi. would have had time to claim their luggage and be gone from the airport before the Mach 1.55T arrives. Mr. Mayes is silent concerning that if the two vehicles were to travel the distance at the same time and traveled the same route, the Mach 1.55T would arrive approximately 15 min. ahead of the Mach 1.5ST; then I would certainly start to see a race history of the mach. Mach numbers above 1.55T would be achieved by Mr. Mayes in his comparison. (Perhaps Aviation Week could publish the required information in tabular form in a future edition.)

For the approximate 30,000 lb difference in cruise altitude, the Mach 1.55T will require more fuel than a Mach 1.5ST to reach an cruise condition as, as described by Mr. Mayes, "while the Mach 1 requires a 10% climb at a subsonic speed."

The 10% climb at a 10% fueling above 1,100 mph. Since I have not been able to find any figures that the two vehicles would go from sonic at approximately the same time if both are subjected to the same sonic boom over pressure boundaries. For all purposes of the argument, let's assume the Mach 1.55T is what the Mach 1.5 SST is in regard to fuel to less than 10%, and the Mach 1.55T is equal to or greater than 20%. If the Mach 1.55T will actually be increasing the ground distance from its Mach 1.5 SST, as is claimed, then the Mach 1.5 SST, during cruise, will necessarily have to fly faster than the Mach 1.55T so that the only purpose of this flight available for the Mach 1.55T to gain in block time, would have to be doing the

Aerospace Week continues the opinions of its readers on the same issue of supersonic transports. Address correspondence to the Editors, Aviation Week, 330 W. 45th St., New York, N.Y. 10036. Try to keep letters under 500 words and to the point. Please type. We will print your comments, but we will not return them.

Aviation Week welcomes the opinions of its readers on the same issue of supersonic transports. Address correspondence to the Editors, Aviation Week, 330 W. 45th St., New York, N.Y. 10036. Try to keep letters under 500 words and to the point. Please type. We will not return them.

possible digressions. The article awards much about the effects on forces or pressure of Edmon's moving picture of the Mach 1.55T's nose cone being hit by the Mach 1.55T's own engine, and ring in our ears.

The spectacular accomplishments of those distinguished thinkers mentioned in the article fact that sonic combustion was right when the critics were wrong, is quite plausible when common folks ignore short on the prospectives of experimental development work. It appears to be a harbinger of new enough prominent persons in charge Mr. Edmonson, to offer his development to government to prove.

Ronald Stevens
Pilot Engineer (N) J
Van Nuys, Calif.

Nova Project Costs

Since, once associated with the Nova project raised one of my dear friends. He argues they discussed project costs set in the range of \$100 billion to \$150 billion NATIONAL PRODUCT?

It appears that we ought to consider others had better write before they figure the minimum valuation level of our projects and influence the rest in a galactic perspective.

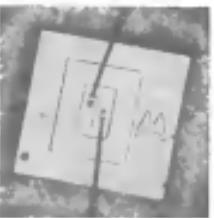
Ronald J. Farnham
Northridge, Calif.

Trademark Challenge

In reading through your magazine of the week July 1 (p. 60) I found the article about the Women's Tennis Association.

I happen to like their claims and confuse a sample (not a pattern) of the Missouri Gymnasium Men's and in particular that one made a model, but no claim is made as to the being the world's first. Missouri Gymnasium Men's and 0.004 x 0.004 m. measured in 0.006 m. diameter of the Writing house "W".

Ronald R. Bowers
Vice-Chairman Semiconductor Products Dept.
General Mills Products Dept.
Phoenix, Ariz.



Stellar Skeptics

Considerable space has been devoted to letters arguments on the merits of various space flight projects. It is not particularly remarkable that technical persons were and are from the start skeptical. Let me add my eighth great concern. I am grateful to Dr. John E. Cullen to Goddard and Dean Parker to Lockheed, embroiled with com-

F-111 Feasibility

As a qualified aeronautical engineer and a person thirty years involved in the defense effort, I would like to offer my thoughts on a recent defense issue, for your consideration.

The issue I have in mind is the TFX (F-111) aircraft. While the Defense Department and Congress appear to be kept fully located and believing about what they should do, the TFX is considered the quintessence of what the aircraft industry could possibly come to have been designed. It is almost as though they have availed of the common sense and are starting at the goal.

There is no question in a measurement Mach 2 aircraft with a range based on higher speed capabilities. In position in the free world today are numerous Mach 2 tactical aircraft. True, they may not be acknowledged but the two quite possibly posses the whole spectrum desired. As far as the TFX is concerned, the starting point is also the goal.

As one who can sit in the expansive wilderness, I would like to see an averaging of the TFX concept. According to several reports from the control group, the aircraft cost of this program may well exceed \$12 billion. The Space approach 60% of our national dues on the same cost!

In an effort to limit weapon concepts rapidly repeat and a man on the moon program cost is much higher, can we not evaluate our position on the matter? S. D. DeGrazia
Los Angeles, Calif.

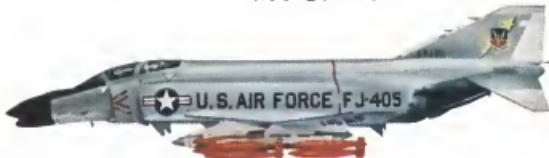


Convoy...saved by a Bell Antisubmarine warfare is a silent, subtle war of wits with no room for second place. During World War II, for example, submarines sank 2800 Allied ships. Space-age achievements of nuclear propulsion and sophisticated ballistic missiles make modern submarines an even deadlier weapon system. Many new antisubmarine warfare weapon systems are being investigated including vertical take-off and landing aircraft/VTOLs combine the hovering and vertical flight capabilities of helicopters with the speed and long endurance advantages of airplanes. Operating from small, fast carriers or from freighters modified for convoy protection, future VTOL aircraft could match the mobility of modern submarines and deliver a torpedo on target. Bell is developing the Tri-Service X-22A dual tandem ducted propeller VTOL research aircraft for the U.S. Navy to determine its state-of-the-art and suitability for a variety of missions.



BELL AEROSYSTEMS COMPANY
DIVISION OF BELL AEROSPACE CORPORATION

AUG. 27 1963



**DON'T INTERRUPT
A PHANTOM...**

**...IT
CAN
TURN
ON
YOU**



Phantoms assigned to air-to-ground attack missions retain the capability and armament for instant assumption of intercept and air superiority roles.

MCDONNELL

*Gemini, Asset and Aeroballistic Spacecraft •
Phantom II Fighter, Attack and Reconnaissance Aircraft • Electronic Systems and Equipment •
Talos Missile Airframes and Engines • Automation* ST. LOUIS

Engineers and Scientists: Employment opportunities exist at McDonnell. An Equal Opportunity Employer. For information, write: McDonnell, Box 516, St. Louis 66, Mo.